Electrical Contracting

JUNE 1944

The Magazine of

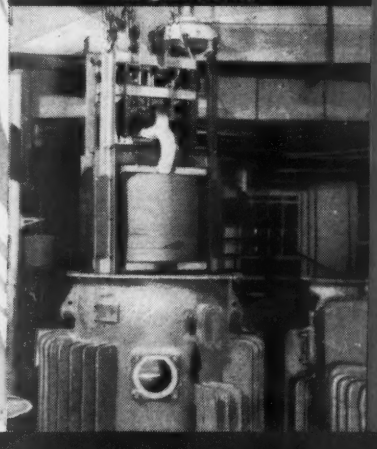
ELECTRICAL CONSTRUCTION AND MAINTENANCE

BUY ONE OF THESE BONDS TODAY

3 Pictures Worth 30,000 Words of Proof That:

"Pyranol transformers cannot burn or contribute to a fire"

Core and coils were found as good as new



They stood up under fire

They came through a $50,000 fire virtually unharmed. Although surrounded by flame, they did not add to the fire.

Several bushings had to be replaced, and tanks repainted—that was all

ONE of the many benefits to be obtained from the installation of Pyranol* transformers was amply demonstrated recently when 12 Pyranol units were subjected to a severe external fire at a new war plant in the South.

From the field engineer's description of the fire, it is obvious that transformers without noninflammable liquid, subjected to the same conditions, would have been almost a total loss. And it has been estimated that, with some types of transformers, the damage to the plant might have run as high as half a million dollars.

*Reg. U. S. Pat. Off.

The only reconditioning found necessary was the replacement of several bushing porcelains which were cracked by the heat, the painting of the tanks, and the addition of a small amount of new Pyranol to make up for that lost through the bushings.

The transformer interiors were in perfect condition. It was not even necessary to filter the Pyranol.

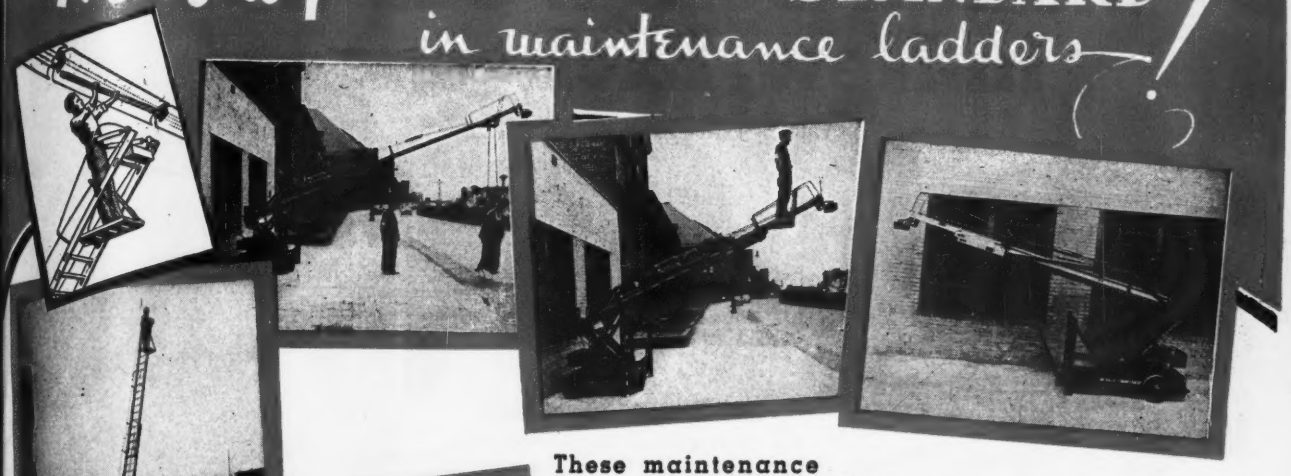
Here's an experience that proved the wisdom of investing in Pyranol transformers, from the standpoint of safety and reduction of losses from fire. *General Electric Company, Schenectady, N. Y.*

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds

GENERAL ELECTRIC

402-63-5100

"Murray" – the modern STANDARD in maintenance ladders!

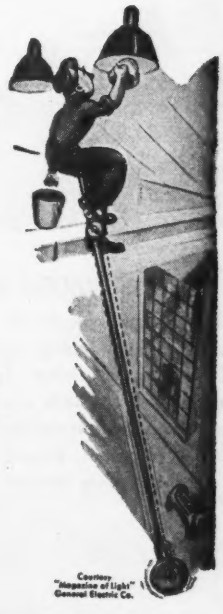


These maintenance units make overhead servicing *so* fast and easy that light output is kept at maximum.

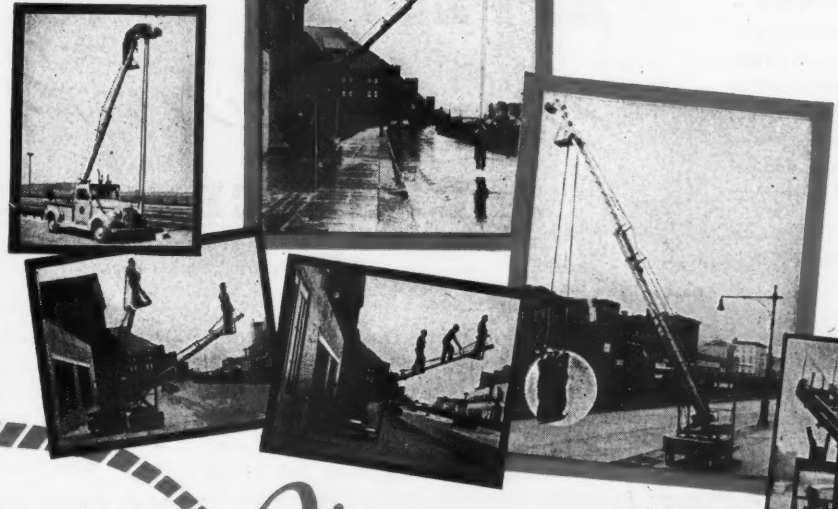
The chief advantage of these Murray Crows'nests is that they make overhead, out-of-the-way lights, unit heaters and sprinkler heads, easily accessible, without disturbing men, machines or production schedules in the slightest.

All the many important plants which have taken on Murray Crows'nests, wonder how any plant ever got along without them. Fill in the coupon and mail—we'll propose a unit suiting your particular needs. Metropolitan Device Corporation, Brooklyn 16, N. Y.

Courtesy "Magazine of Light" General Electric Co.



Courtesy "Magazine of Light" General Electric Co.



Metropolitan Device Corp.
Brooklyn 16, N. Y.

Send data (without obligation) on Murray Crows'nest suitable for our requirements.
Ladder must reach feet high, and extend feet side-ways. Aisle width is feet.

Name and Title_____

Company_____

Address_____

Murray crows'nest

ELECTRICAL CONTRACTING. Published monthly, price 25 cents a copy. Vol. 43, No. 6. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication Office, 99-129 N. Broadway, Albany, N. Y. All communications about subscriptions should be addressed to the Director of Circulation, Electrical Contracting, 330 West 42nd St., New York 18, N. Y. Subscription Rates—U. S. A. and Latin American Republics, $2.00 a year, $3.00 for two years, $4.00 for three years. Canada $2.50 a year, $4.00 for two years, $5.00 for three years. Great Britain and British Possessions, 18 shillings for one year, 36 shillings for three years. All other countries $3.00 a year, $6.00 for three years. Entered as second-class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S.

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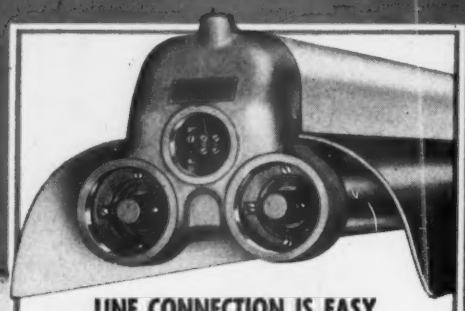
MARVEL OF SIMPLICITY

Skillful Design Cuts Costs in New, Exclusive...

Approved for All Class I, Groups C and D Class II, Groups E, F and G Hazardous Locations

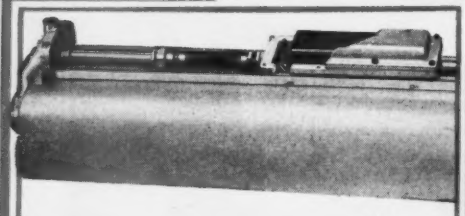


LINE CONNECTION IS EASY

End view with explosion-proof screw covers removed. Connecting block in upper hole simplifies installation. No other connections are made on the job. Lower holes show easily accessible starters, which can be replaced without removing lamps.

RE-LAMP IN A JIFFY

Two 40-watt, 48-inch, T-12 lamps, supported by wire cradles in tightly-sealed explosion-proof Pyrex tubes. Cradles seat lamps easily at far end. Special tool furnished for engaging electrodes in handling lamps.



BALLAST QUICKLY ACCESSIBLE

Mounted in explosion-proof housing at center of unit, under outer dust cover. Easily reached when replacement is necessary. Flexible coupling relieves any possible strain on Pyrex tubes. Highly-efficient, baked white enamel reflectors easily removed for washing.

APPLETON *Explosion-Proof* FLUORESCENT FIXTURE

Simple, low-cost installation and quick, easy maintenance are part of the design of the new Appleton Explosion-Proof Fluorescent Lighting Fixture. They're *built-in!*

Economy of man-hours makes doubly attractive the many advantages of fluorescent lighting in hazardous locations working night and day in war production. Allowing for the fact that all wiring must be tightly enclosed to guard against explosion, every operation in installation and maintenance is as simple as with ordinary fluorescent equipment. Additional maintenance cost is no factor.

Skillful Appleton engineering, so marked in this latest Appleton achievement, is common to all Appleton products—"Unilets," both regular and explosion-proof; lighting fixtures; conduit fittings; outlet and switch boxes. All of the thousands of types are carefully designed to install easily, to stand up on the job, to give maximum low-cost service.

Look carefully at the illustrations above, they'll tell you, *plainly,* why Appleton Explosion-Proof Fluorescent Lighting Fixtures should be in every hazardous location in your community—why it's wise, *on every job,* to specify Appleton equipment—"STANDARD FOR BETTER WIRING!"

Sold Through Wholesalers

APPLETON ELECTRIC COMPANY
1704 WELLINGTON AVE. • CHICAGO 13, ILLINOIS

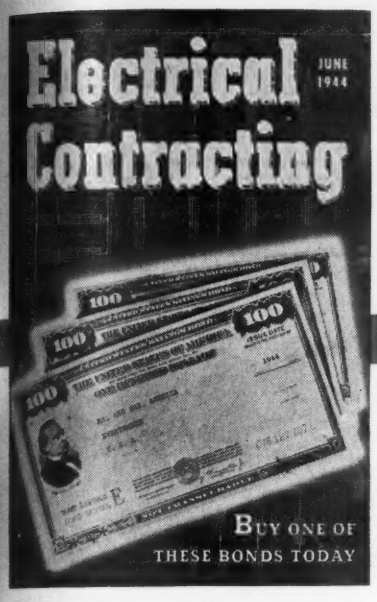
Branch Offices: NEW YORK, 76 Ninth Ave. • DETROIT, 7310 Woodward Ave. • CLEVELAND, 1836 Euclid Ave. • SAN FRANCISCO, 655 Minna St. • ST LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Ave. • ATLANTA, 175 Luckie St., N. W. • BIRMINGHAM, 6 N. Twenty-first St. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 418 Bessemer Bldg.

Resident Representatives: Baltimore, Boston, Cincinnati, Dallas, Denver, Kansas City, Milwaukee, New Haven, New Orleans, Philadelphia, Seattle

APPLETON ELECTRIC - PRODUCTS REG. U.S. PAT. OFF.

APPLETON

CONDUIT FITTINGS • OUTLETS AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • RECEPTACLES



The cover design of this issue, in cooperation with the Fifth War Loan Drive, is a reminder to "Buy One of These Bonds Today."

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

Electrical Contracting

Wm. which is consolidated The Electrical and Electrical Record . . Established 1891

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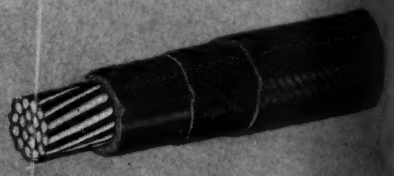
1844 - One Hundred Years of Telegraphy - 1944

from the needs of telegraphy Okonite wire and cable research was born



JOHN HAVEN CHEEVER, pioneer rubber manufacturer, was started on the great research job that ended in his founding The Okonite Company when his friend Samuel F. B. Morse suggested the need for a rubber insulation that would protect telegraph wires in damp places.

Cheever succeeded and Okonite's first major work was in supplying covered telegraph wire that helped our fast expanding nation get its messages through, despite trying conditions of heat and moisture.

So it has been for 66 years. As insulated wires and cables were needed for new developments, Okonite research supplied them; frequently our investigations have indicated far reaching possibilities in cable insulations and cable construction which have found valuable applications. In a number of instances we have developed new synthetic compounds which time has proved are superior in many respects to those made from natural materials.

Okonite research is not an abstract, theoretical venture. It's a down to earth, practical branch of our business. Its results are of benefit to — and available to — all our customers. It's both general, in a broad sense, and very specific in its search for perfection and discovery in individual fields.

A report, made over 50 years ago, on Okonite Cables by English scientists who found Okonite Insulation "excellent".

For a discussion of Okonite wire and cable research, with concrete examples, write for Bulletin OK-1005A, a well illustrated 36 page booklet.

The Okonite Company, Passaic, New Jersey.

THE DERIVATION OF OKONITE

- **OK** — *A signal flashed by telegraphers indicating message got through.*
- **O** — *To aid in pronunciation.*
- **NITE** — *A suffix used in the early days (as in "vulcanite") to signify "insulation".*

OKONITE

Insulated Wires and Cables

3668

Meet Mr. Quality

ONE LOOK AT Bill Seebode — 50 year man at Allis-Chalmers Norwood Works — tells you that he sleeps well nights.

One reason is that he and hundreds of his fellow craftsmen at Allis-Chalmers have won *and are keeping* the confidence of engineers and operating men throughout American Industry.

That means a lot to veterans like Bill who've made a career of building great motors.

Bill's a stator-winder, as you can see—a living example of the truism that *men* make motors.

No machine known can assemble the maze of wiring and insulation that goes into a stator with his skill and care. No machine can fully test how *well* he's done his job.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test that has proved Allis-Chalmers motors are *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

Yes, hundreds of Allis-Chalmers men—*quality* men like Bill Seebode — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a friend . . . and they know that's something no company and its workers can have too many of. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

• • •

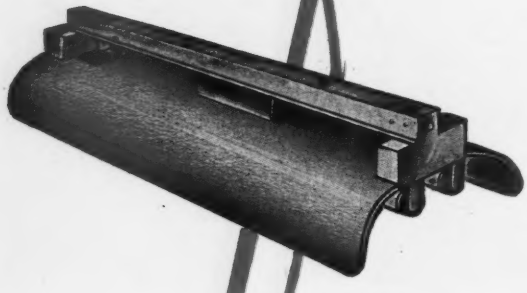
♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

A-C WE WORK FOR VICTORY WE PLAN FOR PEACE

A 1729

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

Neer INSTA-START Fluorescent Industrial



INSTANT-POSITIVE STARTING HAS NO STARTER SWITCHES, TURNS ON AND OFF AS QUICKLY AS AN INCANDESCENT FIXTURE.

This new super-powered lighting unit operates standard 40 watt and 100 watt Fluorescent Lamps. Its insta-start ballast is made and guaranteed for a full year by a leading manufacturer of electrical transformers.

Insta-start units reduce maintenance by the elimination of starter switches. Turn on and off like an incandescent lighting fixture.

Will operate on as low as 85 volts, which is important in plants where load capacities are a problem.

Insta-start units will operate at zero temperatures. Lamps will not blow-out in cold drafts.

Investigate this new Fluorescent Insta-start lighting unit today. Obtainable for immediate delivery.

INSTA-START OUTSTANDING 50-A-SERIES FEATURES . . .

1. It's easier to install with this new rigid simplified construction.
2. Entire wireway and ends may be exposed quickly, without taking fixture down.
3. May be surface, chain or stem mounted singly or in continuous runs.
4. Exposed ballast gives longer life and cooler operation. Inverted under channel.
5. Special K. O. for pull switch is provided in lamp holder cover.
6. Complies with all W.P.B. and U. S. Bureau of Standard Regulations.
7. Underwriters' Laboratories approved equipment used in all these fixtures.
8. Union Made—International Brotherhood of Electrical Workers, A. F. of L. Bear their label.

All Metal Commercials & Industrials

AVAILABLE FOR EARLY DELIVERY

Designed to deliver the maximum of light and embodying many unusually attractive design features, the new L. P. I. all Steel Commercial and Industrial Fixtures will more than meet your most rigid requirements. Inquire now about types soon to be available.

LIGHTING PRODUCTS INC. HIGHLAND PARK • ILLINOIS

It "Grips like Magic" to Give you faster, safer, better Mounting!

Allis-Chalmers' new "Magic-Grip" is the *fastest mounting sheave on the market.* Three cap screws lock tapered split bushing, sheave and shaft securely . . . *in one operation.*

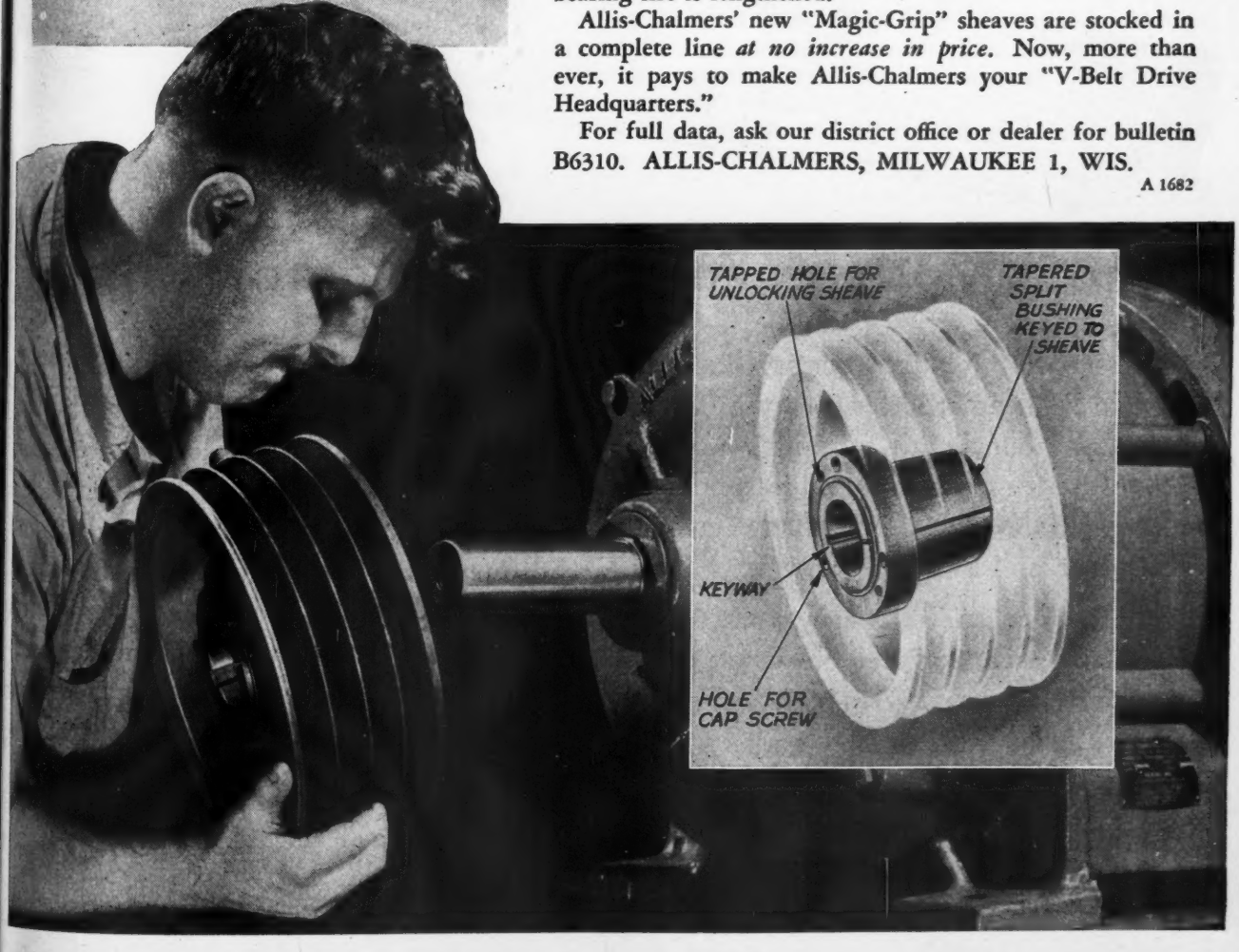
YOU get smoother running performance with "Magic-Grip" because . . . its positive clamp fit grips motor and machine shafts uniformly, eliminating back-lash and shear.

Vibration and stress resulting from shaft overhang are greatly reduced, too, since new design allows the sheave that "grips like magic" to be mounted closer to motor. Motor bearing life is lengthened.

Allis-Chalmers' new "Magic-Grip" sheaves are stocked in a complete line *at no increase in price.* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Drive Headquarters."

For full data, ask our district office or dealer for bulletin B6310. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1682



Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

Now Wakefield brings you ..the New BEACON

to help you serve your customers *better!*

DESIGNED for high quality fluorescent lighting at lower cost, the BEACON is a "honey" for lighting essential offices or drafting rooms. Provides smooth, shadowless light to help handle paper work faster and reduce eyestrain.

Maintenance is especially easy since there are no horizontal surfaces on which dust can collect. Hinged louvers make lamp replacement easy.

Etched, ribbed glass on the side panels gives smooth, pleasing light; louvers on the bottom of the unit prevent direct view of the lamps.

Ballasts are only partially enclosed – which means cooler, better operation.

The new BEACON is of all-steel construction. Metal end caps are pierced in a decorative design and are backed up with diffusing, translucent plastic. And you can offer this 4-lamp fluorescent unit in stem suspension as pictured, or with close-up mounting for low-ceiling areas. Get the details NOW from Graybar or write us.

★ ★ ★

HELP PREVENT INDUSTRIAL ACCIDENTS . . . GUARD MOVING PARTS . . . HAVE GOOD LIGHT . . . BE ALERT.

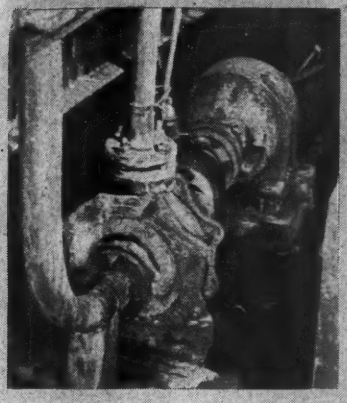
ARMY E NAVY

THE F. W. Wakefield BRASS COMPANY

RED SPOT LIGHTING FOR WAR PRODUCTION . . . FOR PEACETIME FUTURE

VERMILION, OHIO

DOSE OF SALT

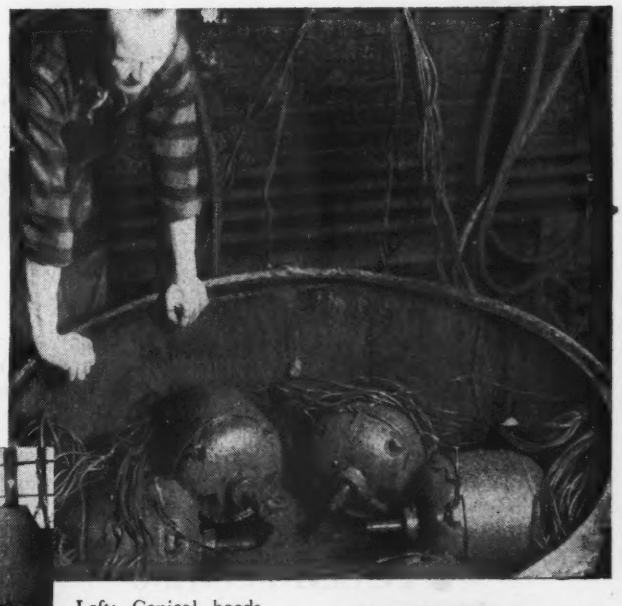


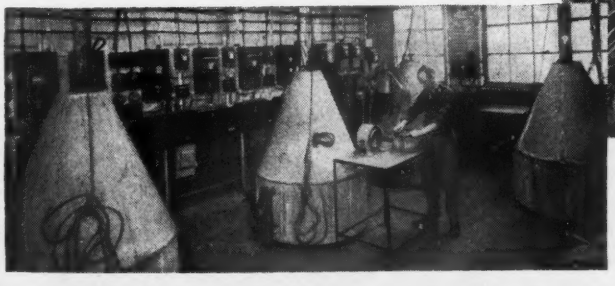
Encrusted with chemical salts, this Tri-Clad motor continues to drive a pump without breakdown of its insulation. In almost every industrial plant, motors are called upon to keep going under conditions which try their endurance to the limit. It may be in a plating room, or on an exhaust fan, or in a wet sub-cellar, or — as in this case — in connection with chemical processing. In emergencies, open motors may face conditions for which good engineering practice would require totally enclosed construction — conditions which tend to corrode the frame and attack the insulation. Endurance of Tri-Clad motors under such conditions results from tests like the one described below.

Salt-spray test of TRI/CLAD motors gives assurance of long life in severe service

In this accelerated life test to determine the ultimate endurance of their insulation, the motors are operated to failure under one of the worst possible combinations of conditions. They are continually exposed to a 2% salt-water spray, while operating on a duty cycle of 3 minutes on and 37 minutes off. (These repeated voltage surges impose greater stress on the insulation than would continuous operation.) Tests are run on all new insulations developed, and as a production check on motors taken at random off the assembly lines. Because of their endurance under this severe test, among others, Formex* wire and Glyptal* bonding material were chosen for Tri-Clad insulation.

*Reg. U. S. Pat. Off.





Left: Conical hoods cover the tanks in which these salt-spray tests are conducted.

GENERAL ELECTRIC

750-240-5030

TRI/CLAD REG. U.S. PAT. OFF. MOTORS

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

Do you know that there are two kinds of

Fluorescent Lighting?

● ***For Better Light—Longer Life—Use ZEON Cold Cathode, Fluorescent Lighting.***

- LONGER LAMP LIFE
- LOWER MAINTENANCE COST
- INSTANT STARTING
- CONSTANT LIGHT FLOW
- LESS HEAT
- LESS GLARE
- FEWER AUXILIARIES
- GREATER FLEXIBILITY

FEDERAL ELECTRIC

ZEON

COLD CATHODE

FLUORESCENT LIGHTING

CHANCES are you thought all fluorescent lighting was the same, but lighting engineers will tell you there are two basic types—"Hot" and "Cold Cathode." Of the two, "Cold Cathode" is the latest and a most important development because it brings to fluorescent lighting an entirely new conception of performance, economy and flexibility.

ZEON, the outstanding example of Cold Cathode Fluorescent Lighting, is a development of Federal Electric Company, Inc., who for over fifteen years have been leaders in the field of gaseous discharge lamps.

The great number of successful industrial and commercial installations have established the high efficiency of this unusual light source. Higher levels of illumination at lower cost—lamp life averaging 10,000 hours or more—flexibility of any size, shape, or design of installation—are a few of the features that have made ZEON the choice of wise fluorescent lighting buyers.

Learn more of this better light source before you make a decision on any fluorescent lighting installation. Let experienced Federal Electric engineers work out your lighting problems with you. Their services are available for the asking.

LIGHTING DIVISION

FEDERAL ELECTRIC COMPANY, INC.

6700 SOUTH STATE STREET, CHICAGO (19), ILLINOIS • TELEPHONE VINCENNES 5300

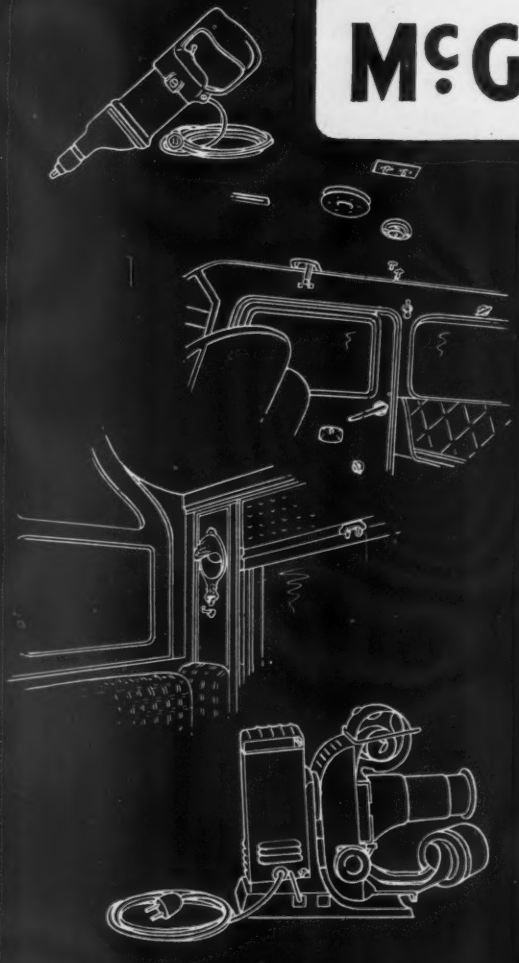
Branch Offices: Cincinnati • Houston • Louisville • New Orleans • Dallas • Indianapolis
Milwaukee • New York • Duluth • Kansas City • Minneapolis • Philadelphia

Subsidiary Company: Federal Brilliant Company, St. Louis, Missouri

Vibration and Dust PROOF

No. 25 Single Pole—Actual Size

McGILL Toggle Switches



Here is a new addition to the McGILL line of dependable switches . . . the McGILL Toggle Switch, Nos. 25, 27 and 28 Series. This small, practical, thin, multiple switch is both vibration and dust proof. With a body only 1″ long, ½″ wide and ½″ thick, it fits into the shallowest of places. Approved by the Underwriters' Laboratories, it is ideal for the individual control of small tools, fractional horsepower motors, industrial and office machines, appliances, motion picture projectors, floor and table lamps, airplane and trailer lights, lights in Pullman cars, passenger cars and busses.

They are made in three types. No. 25 single pole rated 6 amp. "T" 125 volts, 3 amp. 250 volts. No. 27, three way, rated 6 amp. 125 volts. No. 28 two-circuit, no off position, rated 6 amp. 125 volts. All types furnished with wire leads or solder lugs.

McGILL Toggle Switches are easily installed and built for long life. See your dealer, or write for further information.

McGILL Manufacturing Company, Inc.

Electrical Division VALPARAISO, INDIANA

PLUG IN ANYWHERE ALONG THE LINE —WITH BULLDOG BUSTRIBUTION DUCT

This photo shows BullDog Bus Duct used on welder circuits. Note the short cable runs from overhead Plugs.

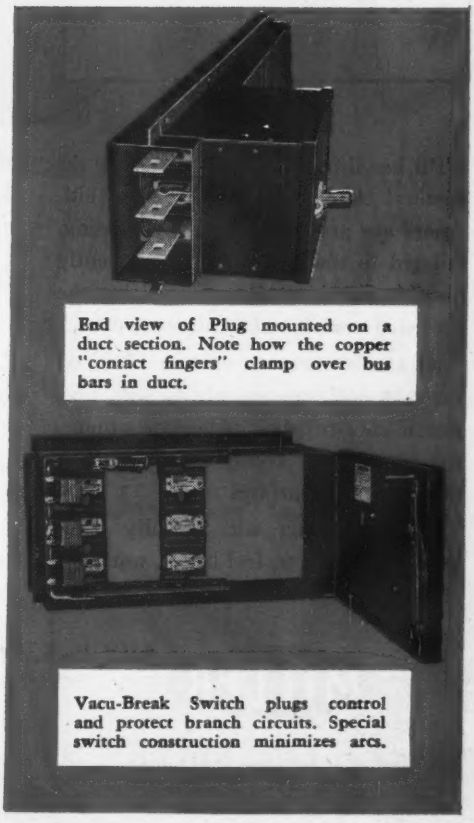
When you install Bus Duct, you wipe out a great many of your electrical power problems.

You can add new machines at will or move old ones to any location because ten plug-in openings are available in each standard 10-foot section of safely-enclosed duct casing.

This gives your workers a constant flexible source of power that is safe . . . convenient . . . clean . . . efficient.

Also, Bus Duct can be easily and quickly installed. Any plant electrician with a couple of helpers can put it up. And it is 100% salvable.

Those plants which have Bus Duct will be a long step ahead in reconverting to peace production. Our field engineers will be happy to help you with *your* power problems. Write today for complete descriptive Bulletin No. 427.



End view of Plug mounted on a duct section. Note how the copper "contact fingers" clamp over bus bars in duct.

Vacu-Break Switch plugs control and protect branch circuits. Special switch construction minimizes arcs.

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

Buy More War Bonds
Get In Your Scrap

ALSO MANUFACTURERS OF

VACU-BREAK SAFETY SWITCHES • SAFTOFUSE PANELBOARDS • SWITCHBOARDS • CIRCUIT MASTER BREAKERS • UNIVERSAL TROL-E-DUCT, *for flexible lighting* • INDUSTRIAL TROL-E-DUCT, *for movable "loads."*

"Gramp" YAEGER'S BACK ON THE JOB!

...and

Miller is back with 100% steel reflectors—the same rigid steel construction you knew and used and liked in 1941 and 1942.

WPB has lifted the ban on steel for reflectors! And WPB says, "When old-timers are provided with good lighting, tailored to their needs, it is frequently possible for them to keep on doing the precision work for which they are fitted."

MILLER 50 FOOT CANDLER or 100 FOOT CANDLER will provide plants with fine, man-made *daylight* . . . adequate, productive illumination evenly distributed over every working surface.

Better lighting will actually make workers see better, feel better, work better. It will help speed production, cut down spoilage, improve worker morale, reduce accidents, and make for smoother-running plants. And by using the Miller System, savings are effected in installation time and materials.

Just under 100 years of lighting experience . . . working with incandescent, fluorescent and mercury vapor . . . has enabled MILLER to offer through its engineers a lighting "expertness" which is at your command . . . to provide the best type of lighting system for your requirements. *Write or wire us today* and we'll get on the job at once.

BUY U. S. WAR BONDS

MILLER

50 FOOT CANDLER
100 FOOT CANDLER
Continuous Wireway Fluorescent Lighting Systems

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844
● **MILLER offers a complete line of filament and fluorescent lighting equipment**

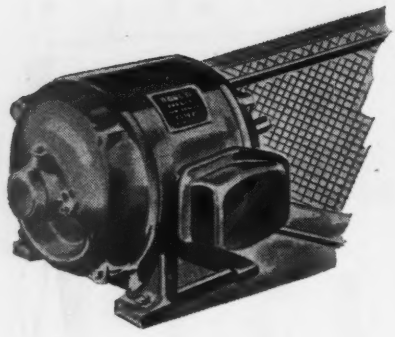
A MILLER Message in line with WPB's helpful handbook, "Plant Efficiency."

PARANITE WIRE AND CABLE CORPORATION

Division of

ESSEX WIRE CORPORATION
JONESBORO, INDIANA

FOR *MORE* OVERLOAD PROTECTION CHECK FIBERGLAS*!



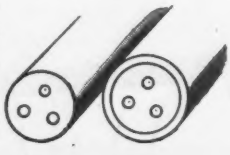
Greatly accelerated production, to meet wartime schedules, often means overloading of electric motors.

That this can be done without frequent breakdown is a tribute to both the motors and their manufacturers. But some motors have stood up better than others. Many of those with outstanding performance records are insulated with varnish - impregnated *Fiberglas* — the glass - fiber insulation.

An exclusive combination of inherent qualities makes impregnated Fiberglas a better electrical insulating material; highly efficient and with the ability to provide an extra "safety factor" against such unanticipated abuse as unusual overload.

Being inorganic and fireproof, Fiberglas is unaffected by high temperatures.

Yet unlike other highly heat-resistant materials, Fiberglas is extremely compact; permits the use of *more* insulation in limited areas than is possible with other types of high heat-resistant insulating materials.



Other basic properties of Fiberglas are: high tensile strength —resistance to acids (except hydrofluoric), oil and corrosive vapors—non-hygroscopic, does not absorb moisture — high thermal conductivity in textile form—permanent—does not deteriorate with age—dimensional stability.

All these properties contribute to longer life and better service for electrical equipment. They make Fiberglas insulation an outstanding value.

May we suggest that you get all the facts about this better electrical insulation. Write *Owens-Corning Fiberglas Corporation, 1856 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

FIBERGLAS *ELECTRICAL INSULATION*

ARMY E NAVY

*T. M. Reg. U. S. Pat. Off.

DUE TO A *Shoestring* PLANT POWER SYSTEM

ACCURACIES that result from eye strain often have an unsuspected *basic* cause—unsuspected because even good lamps and good lighting units can't prevent poor illumination if they are starved for voltage.

DIM LIGHT RESULTING FROM UNDERVOLTAGE near the ends of long feeders is a familiar symptom of antiquated plant power distribution. At the same time, excessive lamp burnouts because of *overvoltage* may be occurring in areas near the power entrance.

MANY KINDS OF POWER SUPPLY TROUBLE—affecting production equipment as well as lighting—are likely to be chronic when the plant distribution system has been extended, piecemeal, to handle loads it was never designed to supply. Makeshift switchgear, hand-me-down transformers, and long overloaded feeders may appear to be "getting you by." Until suddenly—like a shoestring—something snaps! Nurse them through for the moment if you must, but start planning now to replace them.

GENERAL ELECTRIC

HERE'S *News*

of modern electric power distribution—G.E.'s load-center system, which you can plan as a complete installation, and install block by block as you modernize or extend your plant.

VOLTAGE DROP (PER CENT)

0
5
10
15
20

EVERY FOOT OF FEEDER LENGTH

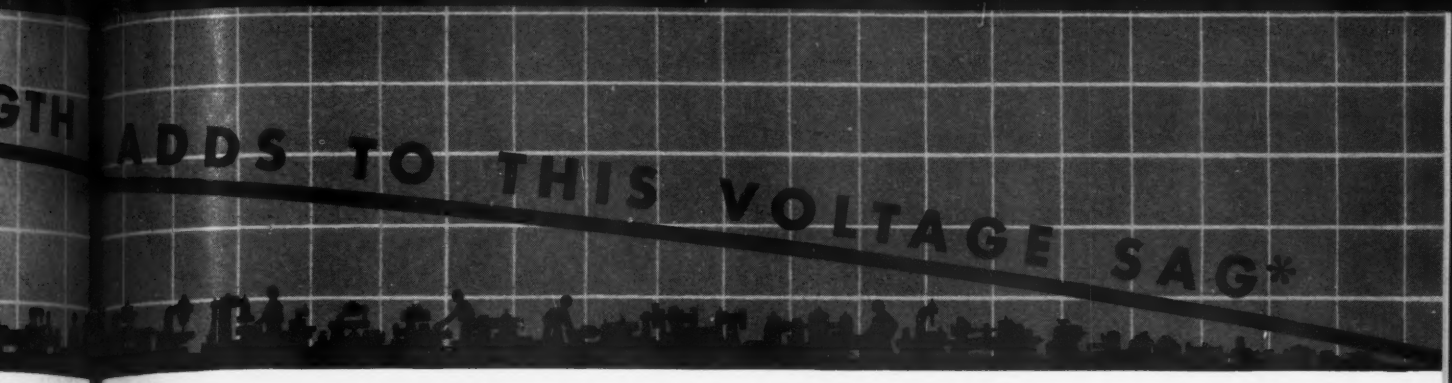
Heavy feeders **required to carry low-voltage power long distances from the switchboard are eliminated by load-center distribution. With this modern system, power is distributed at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations located near the centers of load areas. There it is stepped down to utilization voltage and distributed to the load through drawout air circuit breakers and *short* secondary feeders.**

Change

VOLTAGE DROP (PER CENT)

0
5
10
15
20

SHORT FEEDERS MEAN FUL



*This curve, and those below, are based on an assumed-constant voltage at the plant supply point.

Over to LOAD-CENTER POWER

You can do it a step at a time

VOLTAGE SAGS, outages, and personnel hazards that are inevitable with outdated power circuits can best be eliminated by the use of load-center unit substations throughout your plant.

The great flexibility of load-center power enables you to make the right start without a complete changeover, all at one time, of your present electric power system.

- *To supply electric power to a new plant extension* requiring 200 kva or more, one or more unit substations can be installed to tie in with future modernization in older areas.
- *To eliminate a "trouble-spot" now served by long, overloaded feeders,* a high-voltage line to a new unit substation at the center of that load area will solve the immediate problem on a long-range basis.
- *To modernize a power system without interfering with production,* you can proceed step-by-step, switching over load areas one by one as more unit substations are installed. Eventually, you'll have the same fully co-ordinated system that would go into a new plant.

Before you make *any* additional investment in transformers, switchgear, or cable for piecemeal extensions or replacements, investigate the load-center system. General Electric engineers will help you decide on a *complete plan* of power-distribution modernization, so that every circuit you add, or every equipment purchase you make from now on, brings you closer to a fully co-ordinated load-center system.

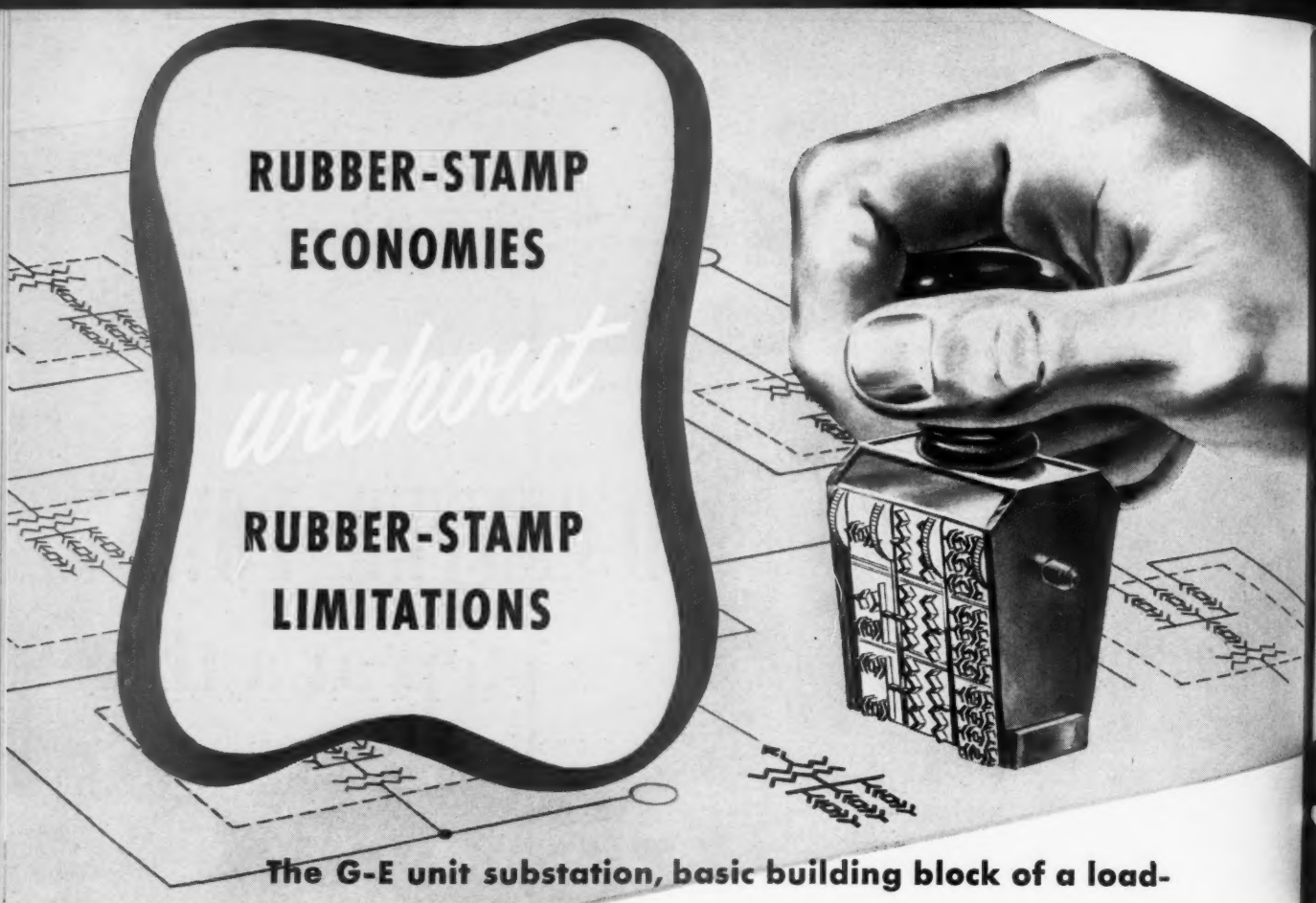
The load-center power distribution system for this industrial plant called for three double-ended unit substations, with Pyranol transformer sections, each located in a production area.

in Contrast

In contrast to a voltage drop of 10 to 20 per cent which sometimes occurs under full load in long secondary feeders (see chart at top of page), the voltage drop in a well-planned load-center system will seldom exceed 3 to 5 per cent (see below). Here's why: First, voltage drop is minimized by high-voltage distribution. Second, transformer-tap settings at each load-center substation are chosen to furnish full voltage required by the load in the local area. Third, low-voltage feeders are so short that voltage drop is negligible. There is no need to supply excess voltage to assure adequate voltage at the end of a circuit.

GENERAL ELECTRIC

RUBBER-STAMP ECONOMIES *without* RUBBER-STAMP LIMITATIONS



The G-E unit substation, basic building block of a load-center system, meets *thousands* of user requirements with *relatively few* parts — all repetitively built

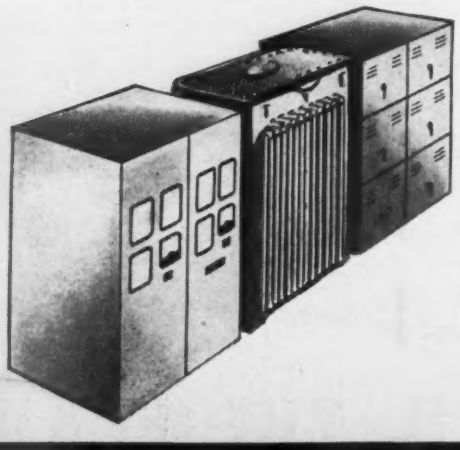
Whatever the power requirements of your plant, or of the load areas within it, G.E. can supply completely co-ordinated unit substations without the extra costs and delays for special design. Whatever the circuit arrangement you choose, a standard combination of incoming-line and secondary protection will meet it. These substations arrive ready to be set in place at the load centers. With a few simple connections, they are ready to go.

They are safely "at home" anywhere in the plant, thanks to the use of a Pyranol* or dry-type transformer section, and fully metal-enclosed switchgear.

In any power distribution system built around G-E unit substations, you can be sure that the interrupting capacity of the breakers is correctly matched to the transformer ratings.

For further information, ask your local G-E representative or write for Bulletin GEA-3758. *General Electric Company, Schenectady 5, N.Y.*

*Reg. U. S. Pat. Off.



The G-E standard-package load-center unit substation includes a safety-enclosed, drawout air circuit breaker equipment properly co-ordinated with a Pyranol transformer. Pyranol transformers, being noninflammable, permit installation indoors without vaults.

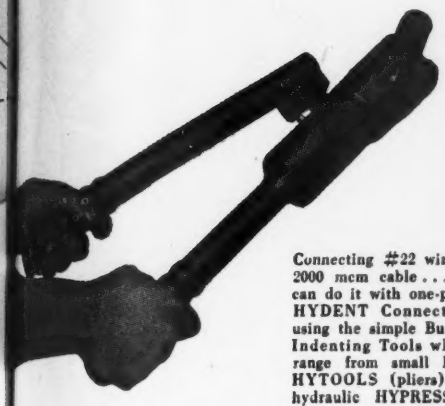
BUY WAR BONDS

LOAD-CENTER Power Distribution Systems

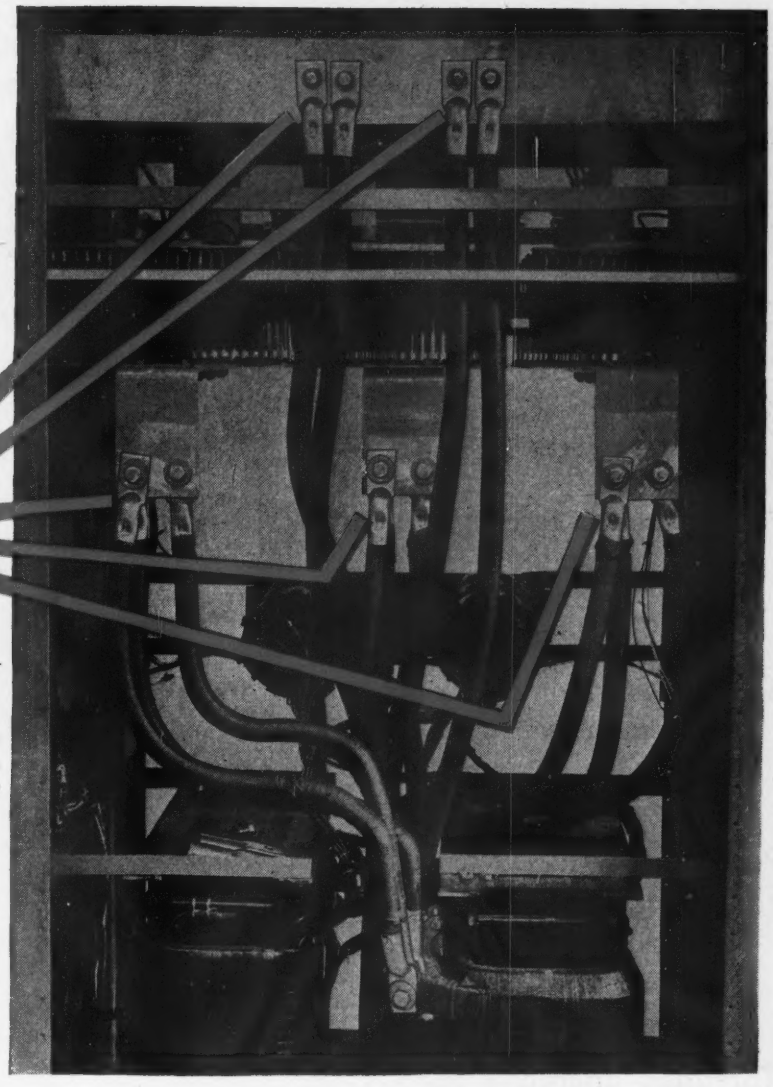
GENERAL ELECTRIC

302-29-5900

Hydent CONNECTORS



Connecting #22 wire or 2000 mcm cable . . . you can do it with one-piece HYDENT Connectors, using the simple Burndy Indenting Tools which range from small hand HYTOOLS (pliers), to hydraulic HYPRESSES.



The Modern Way

. . . to make permanent electrical connections *permanent!*

On circuits everywhere, you now see modern Burndy HYDENT (Indent Type) connections like those above . . . in place of old-fashioned connections made by methods which were time-consuming and uncertain.

The Indent connection has been widely adopted because the indenting principle removes all uncertainty over the strength and permanency of the connection. Further, the HYDENT connectors used are of *one-piece, pure copper* construction . . . assuring highest electrical conductivity. And they are installed in a *fraction of the time* . . . another feature industry likes, too.

Pioneered and proved by utility engineers, the HYDENT connection has been a significant aid to our war effort . . . and will contribute materially to product and production efficiency in the days to come. Bulletin on HYDENT Connectors gladly sent on request.

BURNDY ENGINEERING CO., INC., 107 Bruckner Boulevard, New York 54, N. Y.
IN CANADA: Canadian Line Materials, Limited, Toronto 13

Type WMK Enclosed Safety Switch

CONDULETS

are **rain-tight.** You can use them in **both** indoor and outdoor non-hazardous locations. Also suitable for Classes III and IV hazardous locations. (NEMA Types 3 and 5)

Feraloy cases. Strong and durable. Four sturdy mounting feet. Many possible conduit arrangements for both horizontal and vertical through feed.

Safety. Positive interlock prevents opening the case unless switch is "off." Dead front switch held in "off" position while case is open.

Padlocks.

1. Cover may be padlocked to prevent unauthorized entry.
2. Operating handle may be padlocked "on" or "off."

Threaded operating shaft. Bearings permanently lubricated. Resists corrosion. Prevents the entrance of dust and moisture.

Switches. Quick make and break mechanism. Double break, reinforced, positive pressure-type blade and jaw construction. Positive pressure fuse clips. Combination solder or solderless wire lugs.

30, 60, 100 or 200-Ampere.
1 to 50-H.P.

125 to 600-volt, A. C.

2 or 3-pole, fusible or fuseless.

Listed in Condulet Catalog No. 2500, Section 50, Page 20A.

CONDULETS are manufactured only by CROUSE-HINDS

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City—Los Angeles—Milwaukee—Minneapolis New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington. *Resident Product Engineers:* Albany—Atlanta—Charlotte—New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

TH TRANSTAT A. C. VOLTAGE REGULATOR FOR COMMERCIAL RATINGS AND FREQUENCIES.

6 "EXTRAS" GIVE LONG, UNINTERRUPTED LIFE TO TRANSTATS' SMOOTH CONTROL

Well known for their potentiometer smoothness and transformer efficiency, TH Transtat A. C. Voltage Regulators are strikingly demonstrating another quality—long, trouble-free performance.

The cut-out view above reveals some of the reasons for Transtat ruggedness:

(1) VARNISH IMPREGNATED CORE AND COIL form a solid mass that will not loosen in service.

(2) ADEQUATE TURN-TO-TURN INSULATION AND SOLID INSULATING MATERIAL between commutator bars assured by combination of extra wire insulation and varnish impregnation.

(3) BROAD, UNIFORM COMMUTATING SURFACE results from grinding commutator track on the parallel, uniformly spaced wires of the outside, cylindrical portion of the coil.

(4) SMOOTH, COMMUTATING SURFACE: no bumps jar the brush to cause breakage or arcing.

(5) LONGER BRUSH provides sturdiness, larger heat dissipating surface, and a greater contact area that reduces the current density per square inch of brush contact.

(6) BALANCED COLLECTOR ARM maintains brush setting when mounted in any position.

These features assure long, dependable life for Transtat Voltage Regulators. Yet Transtats are no more expensive than many other voltage regulating devices. For a continuously adjustable voltage or a constant voltage from a fluctuating source, specify Transtats. Write today for complete information covering manually operated Transtats. Ask for bulletin 51-2N.

THE AMERICAN TRANSFORMER CO., 178 Emmet St., Newark 5, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

AMER TRAN

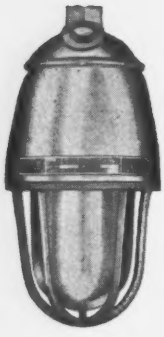
KILLARK FITTINGS

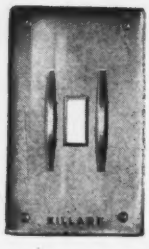
RIGHT DESIGN

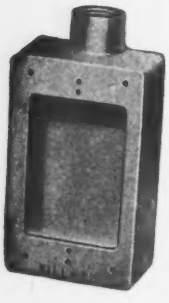
CORRECT INSTALLATIONS

2500 SIZES AND TYPES

MONEY AND TIME SAVERS



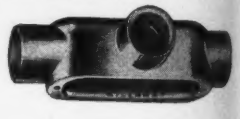




● KILLARK today covers the nation with 14 factory stocks and has distributors in most jobbing centers . . . "on-the-dot" service. Write for the latest KILLARK Catalog featuring the complete line—it gives you prices, types, and sizes.

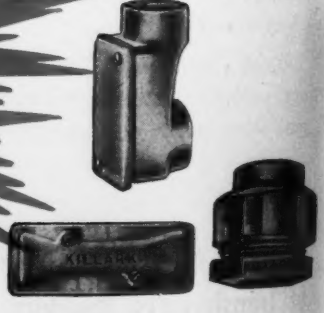
● Smooth finish, highly flexible, flat bottoms—easy to handle and to install—they lie flat and stay put—they eliminate bother and worry.

● Every job is a perfect one—uniformity is one reason—strength is another—they help to line up conduit after fittings are attached.



● There is always the right fitting. KILLARK makes practically all types of fittings so that the right one is always available—each is made to fit the job.

● KILLARK Fittings do save time and money and are easier to handle because they help to line up conduit perfectly and, because they are properly designed, they are more economical to use.



KILLARK ELECTRIC MFG. CO. 3940 EASTON AVE., ST. LOUIS, MO.

Your Peacetime Profits may be Measured in *Kilowatts!*

Your competitors are realizing today that there's many a potential dollar of postwar profits hidden in proper power distribution within their plants. In line with their efforts to cut costs in every direction, they are looking twice at old systems of power distribution, considering ways to make electricity available more dependably, efficiently, and economically to all the places where it will do its work.

Right in your town are men who will help you plan along the same line. Let them start now. You'll be glad you did—later.

Another Way Your Power Company's Engineers Can Help Cut Postwar Costs

YOUR POWER COMPANY'S power engineers know the latest in plant distribution. In fact, utilities themselves have lived through many of the problems you will encounter for the first time, if you plan to change to a more modern distribution system. They have worked these problems out, and have the solutions ready for your use . . . as well as the figures on what better distribution can mean in dollars and cents.

When the time comes to modernize your distribution, remember Roebling as *wire specialists*, a logical source of supply for the wires and cables you'll need for all modernization: better lighting . . . air conditioning . . . power distribution . . . full utilization of the electric and electronic cost-cutters the war has produced.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

ROEBLING
PACEMAKER IN WIRE PROUCTS

Wire Rope and Strand • Fittings • Cold Rolled Strip • Aircord, Swaged Terminals and Assemblies • Round and Shaped Wire Wire Cloth and Netting • High and Low Carbon Acid and Basic Open Hearth Steels Suspension Bridges and Cables • Electrical Wires and Cables • Aerial Wire Rope Systems

STIMULATING INTEREST in postwar electrical modernization, this Roebling advertising in "Mill & Factory" and "Purchasing" reaches 40,000 industrial executives with messages that will help to build business for you.

In a stew about choosing FLUORESCENT LIGHTING?

I LIKE THE CONVENTIONAL SYSTEM WITH FS-4 STARTERS
MAKE MINE THE CONVENTIONAL SYSTEM WITH G-E WATCH DOG STARTERS
HOW ABOUT THIS NEW INSTANT-STARTING WITH G-E LAMPS AND BALLASTS?

AN EXTRA WAR BOND IS AN EXTRA SHARE YOU HOLD IN AMERICA'S FUTURE

Then consider these facts

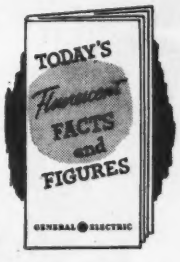
EVER since fluorescent lighting was first introduced by General Electric in 1938, it has been our policy to make a complete line of fluorescent lamps and the ballasts, starters, and sockets for their use. G-E Research is working constantly to improve fluorescent accessories and to find better ways to use them. In buying fluorescent equipment, the following cost factors should be considered:

FIRST COST The conventional FS-4 starter system has the lowest initial cost, the G-E Watchdog Starter system costs approximately 2% more, and the Instant-Starting system costs from 15% to 25% more.

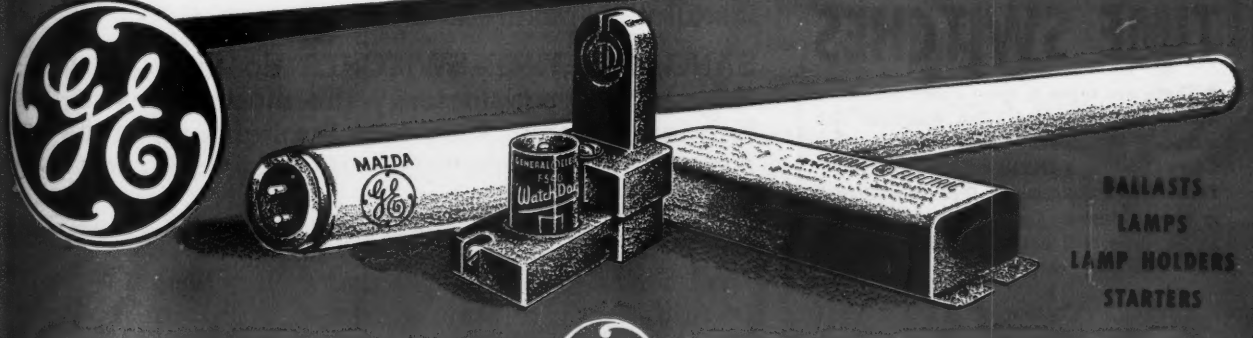
OPERATING COST The FS-4 starter system and the G-E Watchdog system have the same operating cost, while the Instant-Starting system costs approximately 13% more to operate because ballast losses are inherently higher.

MAINTENANCE COST For each dollar spent in maintaining the Instant-Starting system, you will spend about $1.05 for the G-E Watchdog Starter system and about $1.09 for the conventional FS-4 system.

The respective advantages of each system are shown here to help you determine the one which best fits your needs. Whatever system is selected, you can depend on General Electric lamps, ballasts, starters and lamp holders to provide the utmost in fluorescent lighting service.



For an illustrated booklet giving further facts, figures, and a complete comparison of the operating characteristics of the three fluorescent systems, write General Electric at any of these addresses: Nela Park, Cleveland 12, Ohio; Boston Avenue, Bridgeport 2, Conn.; 1 River Road, Schenectady 5, N. Y.



BALLASTS
LAMPS
LAMP HOLDERS
STARTERS

GENERAL ELECTRIC

Hear the General Electric Radio programs: "The G-E All-Girl Orchestra" Sunday, 10 p.m. EWT, NBC; "The World Today" news, every weekday, 6:45 p.m. EWT, CBS.

SANGAMO
TIME SWITCHES

• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSW2 Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

FORGETFULNESS, error, and neglect crop up often to cause serious consequences. Because of these three possibilities in the ordinary operation of floodlighting, you have a powerful weapon in the sale of floodlighting PROTECTION such as is used in installation pictured.

SANGAMO TIME SWITCHES do their job well—they protect satisfactorily the most extensive floodlighting systems. They turn the lights on at the right second and off exactly on the dot. No human guessing or chance-taking.

Now is the time to suggest SANGAMO TIME SWITCHES to floodlight users who haven't this protection. Also, it means added profit for you when selling new floodlighting installations.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

WIRE WITH WALKER

Walker lead-covered cable helps to light our airfields!

Buried under the ice in Alaska . . . mired in the mud of jungle airfields, Walker lead-covered cable is proving its right to serve the contractors of America.

Under all kinds of soil conditions . . . in all kinds of climates all over the world, this cable is defying jungle dampness and desert drought — freezing under ice and frying in the sun!

Designed to meet the tough requirements of the Air Corps, it will more than answer every need of the home front. Walker of Conshohocken offers you a complete line of lead-covered cable and large rubber-covered wire that has proved its quality on the world's toughest testing grounds!

Other dependable products made by walker of Conshohocken

- "Walkerflex" Non-Metallic Sheathed Cables
- Service Entrance Cables
- Automotive Wires and Cables
- Shipboard Cables—Leaded, Non-leaded; Synthetic or Varnished Cambric Insulation
- Electric Metallic Tubing
- "Dualcote" Rigid Steel Conduit
- "Preset-Insert" Underfloor Distribution Systems

Ask your local distributor about prices and deliveries. For further information, write to Walker Bros., Conshohocken, Pa.

WALKER of Conshohocken

WEBSTER ELECTRIC Teletalk Compensates for Empty Desks

An epidemic of empty desks is abroad in the land. Every executive is face to face with the urgent need of doing more work . . . with less people to do it.

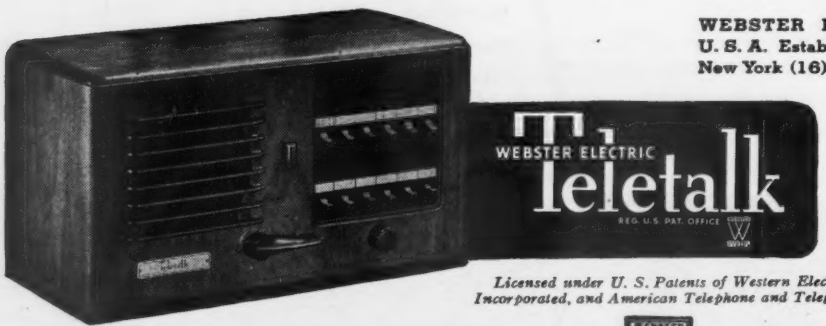
Teletalk Amplified Intercommunication is going a long way to increase the productive time of executives everywhere by giving them quick, easy and personal contact with every department of their business. With Teletalk they can flip a convenient key and ask for production figures, check on orders, direct every detail . . . without leaving their desks.

Whether your office is large or small, there is a Teletalk system exactly geared to keep it running at utmost efficiency. Even a conference can be held with each man at his own desk.

It will pay you to sell them Teletalk . . . show them the modern, effective and economical answer to the pressing man-power problem. Teletalk is inexpensive, easy to operate . . . uses the electric light circuit. It is available in just the proper size for either a large or small office or industrial plant.

If you are not now selling Teletalk, you should get in touch with us at once. Write us today. Let us show you how Teletalk can become a profitable addition to your business.

WEBSTER ELECTRIC COMPANY, Racine, Wisconsin, U. S. A. Established 1909. Export Dept.: 13 E. 40th Street, New York (16), N.Y. Cable Address: "ARLAB", New York City



ARMY E NAVY ★

Let's All Back the Attack—Buy *Extra* War Bonds

Licensed under U. S. Patents of Western Electric Company, Incorporated, and American Telephone and Telegraph Company

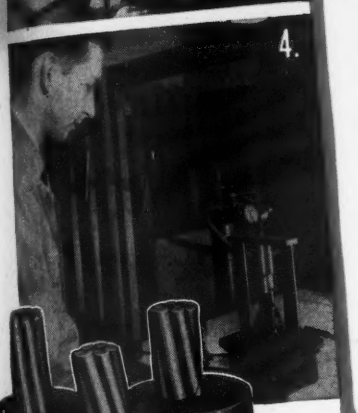
WEBSTER ELECTRIC

"Where Quality is a Responsibility and Fair Dealing an Obligation"

TO GIVE YOU THE FINEST Varnished Cambric Cables YOU CAN BUY . . .

. . . THIS IS WHAT WE DO

1. In our well-equipped research and testing laboratories, the varnished cambric is tested for resistance to the effect of hot oil and solvents.
2. The cambric tape is critically examined for gauge, thread count and tearing strength.
3. Precisely controlled ovens subject it to aging tests far in excess of normal requirements.
4. Samples from each lot are tested for dielectric strength under carefully controlled conditions.
5. And finally, experienced operators apply these improved tapes to the cable, using newly designed equipment that insures proper tension, correct angle of application, and positive control of tape position.



THREE-CONDUCTOR VARNISHED CAMBRIC CABLE LEAD SHEATHED SHIELDED TYPE

THE war has made it necessary for Varnished Cambric Cables to handle much of the load formerly carried by rubber. These cables have been substantially improved to meet more exacting performance requirements.

Higher resistance to heating and aging now permits the cables to carry heavier loads for longer periods. The development of stronger tapes and tougher varnishes provides greater resistance to mechanical abuse and to the action of solvents on the varnished film. More precise methods of application of the tape to the conductor insure more uniform mechanical and electrical properties throughout the cable.

Why not take advantage of the reliability and long-lived performance that these improved Varnished Cambric Cables offer?

Whether you need low voltage wire or high voltage power cables up to 15,000 volt rating (that embody the latest discoveries in shielded cable with PS semi-conducting tapes to eliminate corona formation)—or even a 50,000 volt precipitator lead—there is a type ideally suited to your requirements. Catalog on request.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago, and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

USS

UNITED STATES STEEL

Can you afford an architect

THE TRUTH IS, you can't afford to build *without* an architect! You must have his expert help unless you are prepared to face unforeseen expenses, such as repairing cracked walls, patching roof leaks, replacing unsatisfactory materials. The architect will design a house that avoids such heartaches—that fits your pocketbook as well as your dreams.

Stock plans, which may tempt you as a possible saving, may actually cost more than architectural service, because of things which go wrong. Remember, that plan was drawn by someone who had never seen your lot or met your family. And such cut-and-dried affairs are often devoid of good taste.

The architect will translate your hopes into your own personal home—not just a house. He will supervise it as it grows, protect your interests. There are literally hundreds of ways he can save you his total fee. Send for our new booklet telling how you two can best work together.

If you served on the board of a hospital or school, you would insist on an Architect-Engineer before building. Your home represents as important an investment—protect it the same way!

Plan your house now!
START RIGHT—
WITH AN
ARCHITECT.

EDWARDS
SINCE 1872
ELECTRICAL SIGNALING
Bells · Chimes · Telephones · Alarms
for Homes, Offices, Schools, Hospitals

FREE . . . GET THIS NEW ILLUSTRATED BOOK!

EDWARDS AND COMPANY, NORWALK, CONN.
Please send copy of book "How to Plan Your New Home."

Name_____

Street_____

City_____ State_____

(Save Postage—Paste Coupon on Penny Post Card)

ELECTRICAL CONTRACTORS you're in this picture, too!

Right now millions of prospective home owners are reading the Edwards advertisement on the left. It's one of a series in color now running in Time and in American Home—a series that explains the architect's place in planning that postwar home.

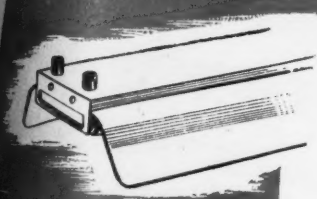
Where do you come in? Well, it's very simple—an architect-planned home is a better planned home, because provision is made for adequate wiring, for better electrical equipment. These advertisements are building up a postwar market for you, besides winning the goodwill of the entire architectural profession.

Is the public interested? definitely! Over 12,000 readers wrote in for the free booklet "How to Plan Your New Home"—in response to the first ad alone; others will appear throughout the year. What interests home owners to this extent is interesting to you. Write for a copy of this booklet now; it is yours for the asking.

Guth Quick-Liter

TRADE MARK

The Original Starterless Fluorescent has proved itself in gruelling tests since July 1942!

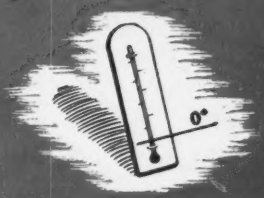


No Starter Switches

Maintenance cost is lower, and the problem of checking for "dead" Starters is eliminated.

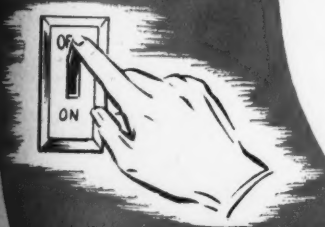
The GUTH QUICK-LITER was first introduced for use in War Plants; where high maintenance costs due to Starter-Switch troubles, and variable line-voltage conditions, made *Starterless* Fluorescent desirable. Detailed performance records were constantly maintained on the tens of thousands in use, with the result that every claim for QUICK-LITER has been *proved* by use.

A valuable report on the results of these tests is now available. Write for your copy today.



Would Operate in an Ice Box

GUTH Quick-Liters start and operate at as low as 0° F. 3,000 Quick-Liters are in daily use in Alaskan and Aleutian Island bases.



Lights Instantly

At the flick of the switch — there's light! No flickering, flashing, or waiting.

Immediately Available

GUTH Quick-Liters can be shipped at once on AA-5, or AA-2-MRO, or higher priorities.

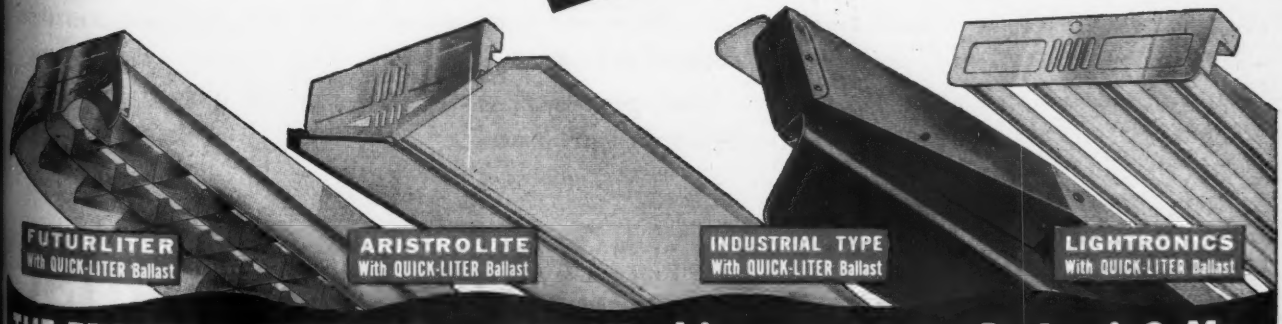
Long Lamp Life

Quick-Liter gets maximum usage from standard or special lamps. In many cases, lamps burned out on Conventional Ballasts and Starters operate on Quick-Liter.

Operates at Irregular or Low Voltage

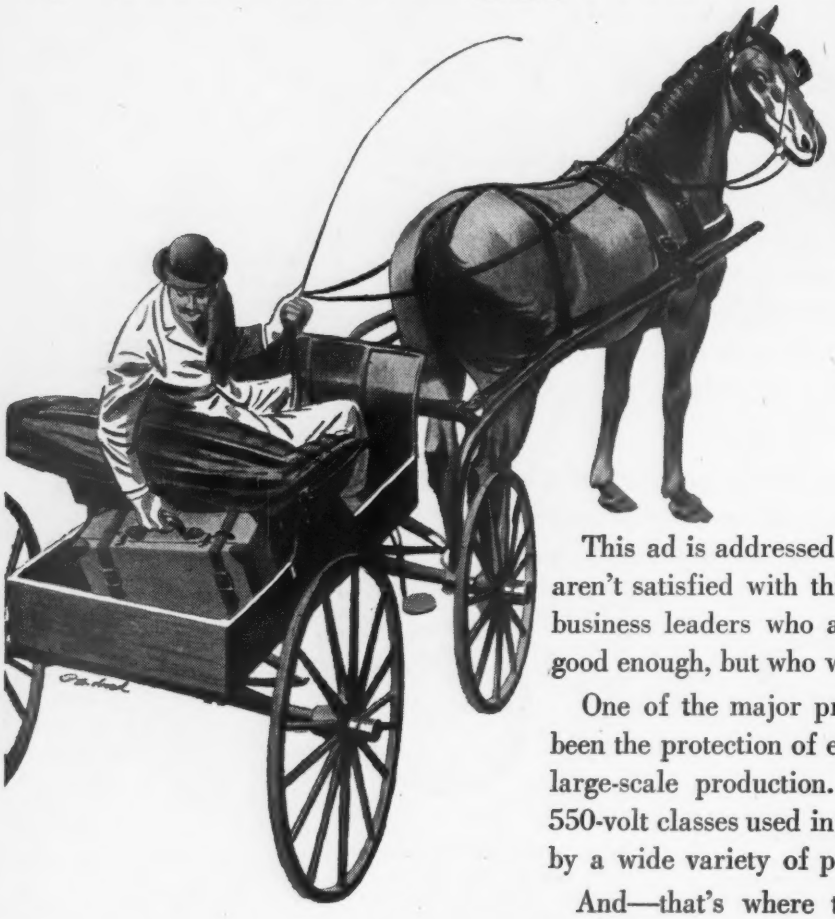
Heavy electrical loads in many plants cause low or irregular voltage. Quick-Liter *starts* and *operates* at as low as 85 Volts.

Leaders in Lighting **Guth** *Since 1902*



THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis 3, Mo.

IF you're satisfied to travel by horse and buggy... or shave by candlelight



don't read this ad

This ad is addressed to those men in American industry who aren't satisfied with things that are merely "adequate" . . . to business leaders who aren't content with devices that are just good enough, but who want something a bit better than the best.

One of the major problems of modern industry has always been the protection of electrical circuits essential to continuous, large-scale production. These circuits (in the 220, 440, and 550-volt classes used in every plant) have been and are guarded by a wide variety of protective devices.

And—that's where the horse and buggy and shaving by candlelight come in. For, most of these devices—while affording adequate protection—are as out of date as Dobbin and the old straight-edge.

They do the job—there's no doubt about that! But, how do they do it? Are they efficient? And—how much do they cost? . . . These are questions to which every businessman should demand definite answers.

And, gentlemen, if you don't insist on the horse and buggy, here are your answers. J-60557

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

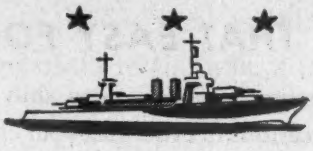
There's only one modern method of Circuit Protection

The "DE-ION" (fuseless) CIRCUIT BREAKER of 1944 . . . . .

This breaker is as far ahead of ordinary circuit protective devices as is tomorrow's streamlined car by comparison with the old high-wheeled buggy.

And—when compared with previous breakers, it justifies the analogy of the modern fluorescent light and the first carbon bulb.

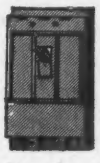
Here's what the "De-ion" (fuseless) Circuit Breaker of 1944 offers to industry:



1. **Provides positive "plus" protection** of productive circuits . . . the same protection that controls circuits on modern battleships . . . where failure may mean defeat.

2. **Permits maximum loading** of circuits . . . will not interrupt circuits on harmless momentary overloads . . . prevents many work stoppages and delays . . . completely eliminates need for replacement of protective devices or parts thereof.

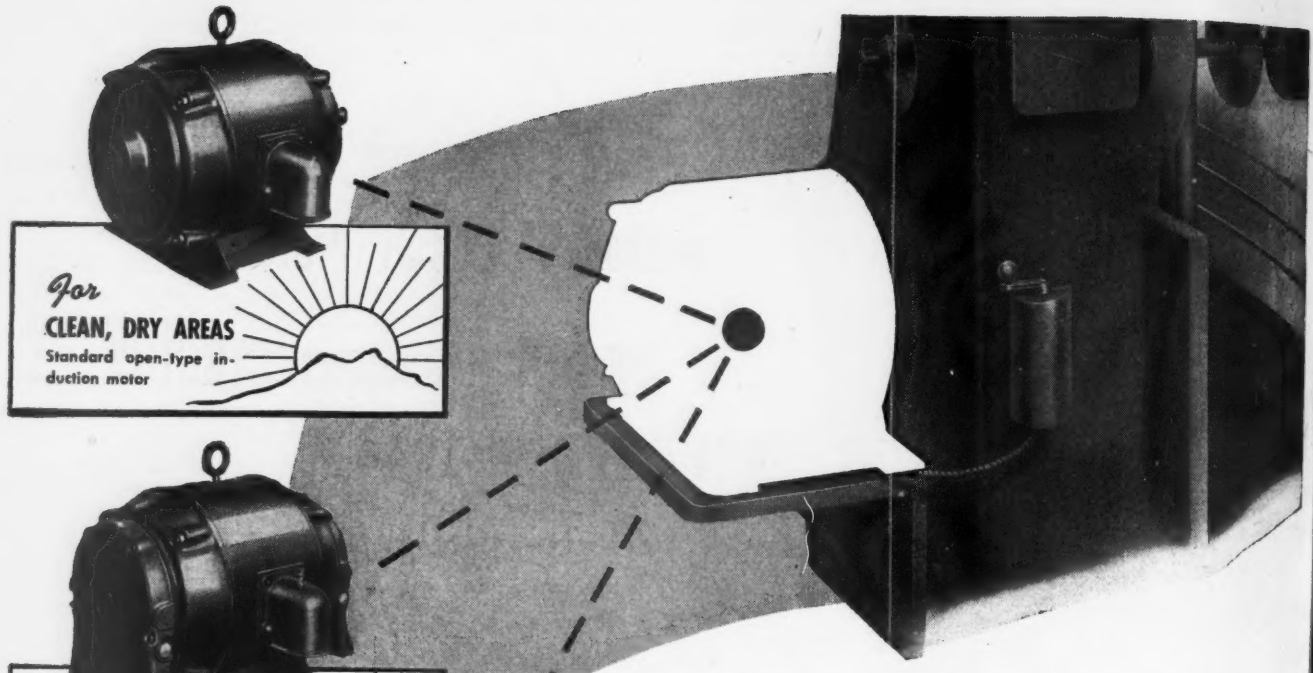
3. **Assures faster resumption of interrupted service** after causes of overloads or short circuits are removed. There is nothing to replace or repair—to restore service, simply throw the handle. This feature alone saves American industry more than one million man-hours yearly.



4. **Guarantees safe operation.** Working parts are completely enclosed and sealed. These breakers are the safest protective devices ever built. They are absolutely tamperproof (cannot be bridged or blocked by pennies, nails or other foreign articles).

and 5. **The lifetime cost of the "De-ion" (fuseless) Circuit Breaker of 1944 is less than that of any other protective device.** Ask any Westinghouse representative for facts and figures. Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa.

"DE-ION" (*fuseless*) CIRCUIT BREAKERS



For
CLEAN, DRY AREAS
Standard open-type induction motor

For
WET, EXPOSED AREAS
Splash-proof, drip-proof induction motor

For
DRY, DUSTY AREAS
Totally enclosed, fan-cooled induction motor

POSTWAR *MOTOR* CONVERSION?

Uni-Shell INTERCHANGEABILITY CAN MAKE THAT EASY FOR YOU!

Will postwar conversion require you to shift motors and machines to other locations in order that your civilian-goods output may be as efficient as your war production has been? If so, other locations may require different motors—open-type, splash-proof, totally enclosed.

R & M Uni-Shell Motors can make the change-over easy for you. Because their shell length, diameter, base mounting holes, bolt circle mounting for heads, height of shaft above base, head fit, and shaft dimensions are exactly the same for any one frame size.

Get all the details on easy, profitable motor application. An illustrated, helpful, 20-page booklet on R & M Uni-Shell Motors is yours for the asking. Send for your free copy of Bulletin 1845, today.

"*Uni-Shell* MOTORS ARE EASY TO CHANGE... AS EASY AS CHANGING HATS!"

SHIPMENT NOW!

Ample stock on most types of integral motors on hand as this goes to press. Wire or phone your inquiry.

ROBBINS & MYERS • INC.
MOTOR DIVISION, SPRINGFIELD, OHIO
HOISTS & CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

THE COST OF *Tomorrow's Peace*

Today peace-loving Americans are united with thirty-three other nations in a common objective of destruction.

Millions of our fine, young men and women find themselves invading foreign lands in order that their own shores may be spared, and their free way of life preserved.

Their sacrifices will be great. Their job will be well done.

But what of the job they will expect of us when they have finished theirs . . . the job of turning their hard-won victory into a lasting pattern of peace?

Can we come up to their great expectation? We must realize that this is the last opportunity of our generation. We must do a better job of it than we did in the Twenties and the Thirties.

We have our backs to the wall, and the scars of World War I and a thirteen-year depression still are upon us. The final test of our way of life is at hand!

As we look over our shoulder into the immediate past, we see little to encourage us. But we also see much to make us pause. We see a tremendous fighting machine, created in a matter of months by the miraculous organization of our resources.

We, the largest of the peace-loving nations, have overnight become masters at the business of waging war. Today, as a result of the coordination of industry, labor, and government, we are producing ***for war alone*** as much as our total normal production for peace.

* * *

We have amply demonstrated our ability to harness the vast productive capacity we possess. Why cannot these resources, which we have organized so efficiently for the destruction of life and property, be directed toward the destruction of the causes of war?

May not the patriotic and emotional strength and the unity of action which have been stimulated for the purpose of winning the war be directed, at least equally well, toward the attainment of world peace and international harmony?

If they are not so directed, what lies ahead but another war? And how can America, in a world that is so rapidly shrinking in size, avoid involvement in ***any*** of tomorrow's conflicts?

International peace is an ambitious dream and its price is high, but the price of war is even higher. Our world cannot long survive the periodic waste of its human and material resources.

Our country can be the most potent single force in bringing about the international understanding that leads to peace, in developing the unity that will make the most of the ample resources nature has provided everywhere.

* * *

There is no unity in selfishness. There can be no unity if any one of the great powers fails to do its part in determining and eliminating from the world the basic causes of aggression.

These basic causes stem from greed and the suppression of opportunity for individual progress; for self-preservation is the first law of nature.

Mussolini's dramatic march on Rome in 1922 was made possible by disillusioned veterans of World War I who could find no jobs and whose future held no promise. Some of Hitler's most

determined followers came from the same ranks.

Men denied the opportunity to make a living, for themselves and for their children, are easy prey to false doctrines and dangerous "isms."

In any realistic appraisal of our domestic problems—economic, labor, racial—it is clear that we can solve them, not by waiting until we reach some utopian accord, but by making a series of compromises. We do this because we know how discord can impair the very roots of private enterprise, self-government, and self-discipline—the essentials of a dynamic democracy.

Similarly, peaceful reconstruction of our world economy depends on the ability of nations to reconcile their differences in a series of working agreements.

If we in the United States want lasting peace and if we want to preserve our democratic way of life, we must take over our full share of the task of initiating these compromise measures. Acknowledging our inescapable responsibility as the greatest economic and military power in the world, we must attempt to insure the free flow of world trade, and develop—with profit for both parties—backward areas abroad as well as at home. And we must do this by making all nations share the responsibility, not by allowing ourselves to be manoeuvered into being an international Santa Claus.

With our allies, we will have to see to it that the devastated portions of the world rehabilitate themselves as quickly as possible; that practicable and realistic trade and economic relations between nations are developed; and that the energies and productive capacities of these nations are set free to function in a climate that is favorable to the growth of free enterprise and individual initiative. As the most powerful economic force on earth, we have the most to gain and the most to lose at the peace table; and we must never forget that with our power comes responsibility.

We cannot hope to solve all of the problems of all nations—nor even all of our own—but our way can become the way for more of the world's humanity. Our strength can become the guiding spirit of the smaller nations.

* * *

In the development of a sound American foreign policy, let us take care not to attempt to control the destinies of other nations. Let us remember that we must set the example of self-determination of independent, free peoples.

Freedom is essential to international peace; and free competition—whether it be between individuals, between businesses, or between nations—is the mainspring, the synchronizer, and the preserver of freedom. For competition always is synonymous with private enterprise.

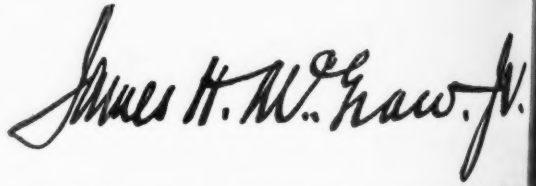
We are not a covetous nation. We have no territorial ambitions. Our international commercial aspirations are dominated by the conviction that we have a great stake in world unity and world prosperity. We know that we can no longer live apart from other nations and that we cannot ignore the fundamental elements which affect the well-being of other countries.

Our foreign policy must encompass a world of trade, and help develop it.

We dare not blunder in the execution of that foreign policy if the American way of life is to survive. A democracy resolved upon isolation is doomed in the world of tomorrow.

Let us resolve that out of this devastating catastrophe we shall emerge with fuller understanding and greater determination to build the kind of world which can materialize only if this country has the vision and the will to see it through.

We still are free to decide our own fate—still free to shape our own future. We still are free to preserve the liberty and happiness that has made our country the hope of the world.



President, McGraw-Hill Publishing Company, Inc.

"Was my face red!"

HORSE: Mr. Manufacturer, I'm representing Horsepower by Howell. I want to save you trouble, save you time and save you money.

MANUFACTURER: That's a big order. You better be sure of your ground.

HORSE: Exacting, eh? That's the kind of customers we like to sell. You see we build a complete line of standardized motors and we also build special motors for special jobs.

MANUFACTURER: Yes, yes, go on.

HORSE: You know it's much more efficient and economical to get a motor with exactly the electrical and mechanical characteristics required to perform your specific job—

MANUFACTURER: Yes, I know. I am a Howell user—and a Howell booster, too . . . You built my motors more than 10 years ago.

HORSE: Put 'er there, brother, we agree! But don't wait so long to tell me the next time that we see eye to eye on electric motors. The suspense makes my face red. Still, it's gratifying to know that so many shrewd buyers specify Horsepower by Howell and like it.

Howell Protected Type Motor, shown, gives plete protection against dripping liquids, metal s and other falling particles. Completely stream- ed—utilizing non-breakable steel frame— leable or steel base—cast iron end plates and iron, weatherproof terminal box are standard struction features. Special horizontal and ver- mountings are available.

Available in sizes 5 H.P. and smaller.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

ARROW all-purpose numbers for flush or surface work

These popular types of Convenience Outlets are available in brown and white "Ivorylite" plastics, as good in looks as they are good in quality. T-slot, with double side-contacts, self-adjusting.

No. 7724—Single, top-wired, Bakelite; No. 8264—Duplex, with 3¼" outlet box cover (4" also supplied); No. 1911—Single, side-wired, Bakelite; No. 1913—Duplex, side-wired, Bakelight; No. 1913-I—Duplex, side-wired, Ivorylight; No 7725-B—Duplex (4 Screws) top-wired, Bakelite. Just the group you need for carrying-on.

ARROW ELECTRIC DIVISION

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

EXPERIENCE WAS OUR DESIGNER

Experience, the sum total of success in solving countless problems in electrical control, guided us in the design of these switches and panel boards. Experience has taught us what to avoid as well as what to do, constructively.

In these well built, long lived devices, simple but powerfully efficient, is the concrete evidence of many years of satisfying our customers. Let us discuss your electrical control problems and offer a solution. Our representatives are located in principal cities, coast-to-coast.

600 Volt Relarc Type Knife Blade Switch — 30 to 600 amperes, 575 volts A.C. and 600 volts D.C. Maximum horsepower rated. Equipped with quick make and quick break mechanism and patented Federal Relarc arc snuffers. Available fusible and not fusible — 2, 3 and 4 poles. Equipped with Federal positive pressure type fuse clips.

A smartly designed enclosure completes this sturdy, compact unit and protects Federal Switches.

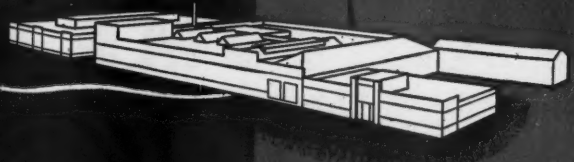
Concealed Arc Switch with rotary sector type contacts. 30 to 200 amperes, 230 volts A.C. and 750 volts D.C. Quick make, quick break, equipped with defeatable cover interlock control. Fusible and not fusible. 2, 3 and 4 pole — 3, 4 and 5 wire solid neutral. Equipped with Federal positive pressure type fuse clips.

Raintight Switch with Federal visible knife blade construction. 100 amperes, 2 pole, 250 volt D.C. no-fuse Type C. Equipped with cable strain hook. All Federal switches are available in raintight enclosures.

Federalite NTPS and NTPR Lighting Panelboards equipped with quick make and quick break toggle-type switches, molded Bakelite units with heavy duty switch handles. Available from 4 to 40 circuits.

Federal

ELECTRIC PRODUCTS COMPANY
50 Paris St. • Newark, N. J.



SAFETY SWITCHES • PANELBOARDS • SWITCHBOARDS • CIRCUIT BREAKERS

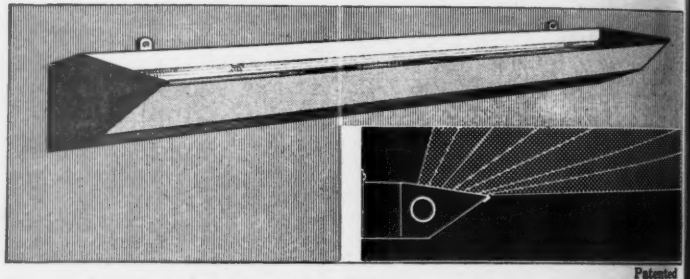
DISINFECTAIRE

(REG. U. S. PATENT OFFICE)

Units for the Disinfection of Air

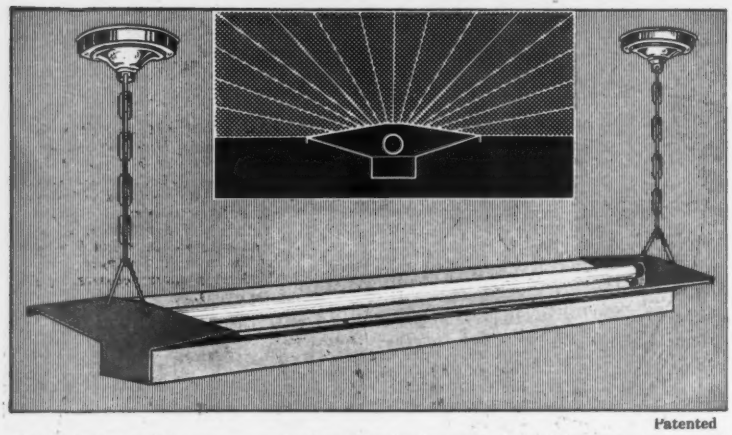
Utilizing the G-E Uviarc

The DISINFECTAIRE opens an entirely new market to electrical wholesalers and contractors that promises, at the most conservative estimate, to equal in size and profitableness the original lighting installation. DISINFECTAIRE is in no sense a lighting application. On the contrary, its definite function is to reduce airborne bacteria by disinfecting the air with ultra-violet germicidal radiation. Anyone familiar with continuing studies of successful installations, knows that ample proof exists that shortwave (2537A) ultra violet radiation will kill all airborne bacteria exposed to this energy for a long enough period of time.



Patented

One 30-watt Disinfectaire Unit will kill 90% of the disease producing germs in 700 cubic ft. of air in one minute. Controlled and safe.



Patented

Made for portable or permanent installation in wall and ceiling types in 15 and 30-watt sizes. Appearance and finish blend with any interior. Tamper proof.

Who Are Your Customers?

Hospitals, schools and doctors' offices are immediate prospects. You will find many of them informed and deeply interested. *You should have* samples of DISINFECTAIRE and a full set of literature that gives the facts concerning the Disinfectaire Units. *Why is this important now?* First, because you have to sell on the basis of fact. Correct, scientific information must be submitted to hospital and school authorities long in advance of purchase. Second, if you give them this information *now,* you will be ready to do business in the postwar period.

Here is an opportunity to render a bona fide public service—at a legitimate profit.

Our DISINFECTAIRE Catalog should be in your hands.

Unusual in its wealth of interesting data, this Catalog gives accurate information. Your request will be quickly honored. Send for it now.

Of Vital Importance to You

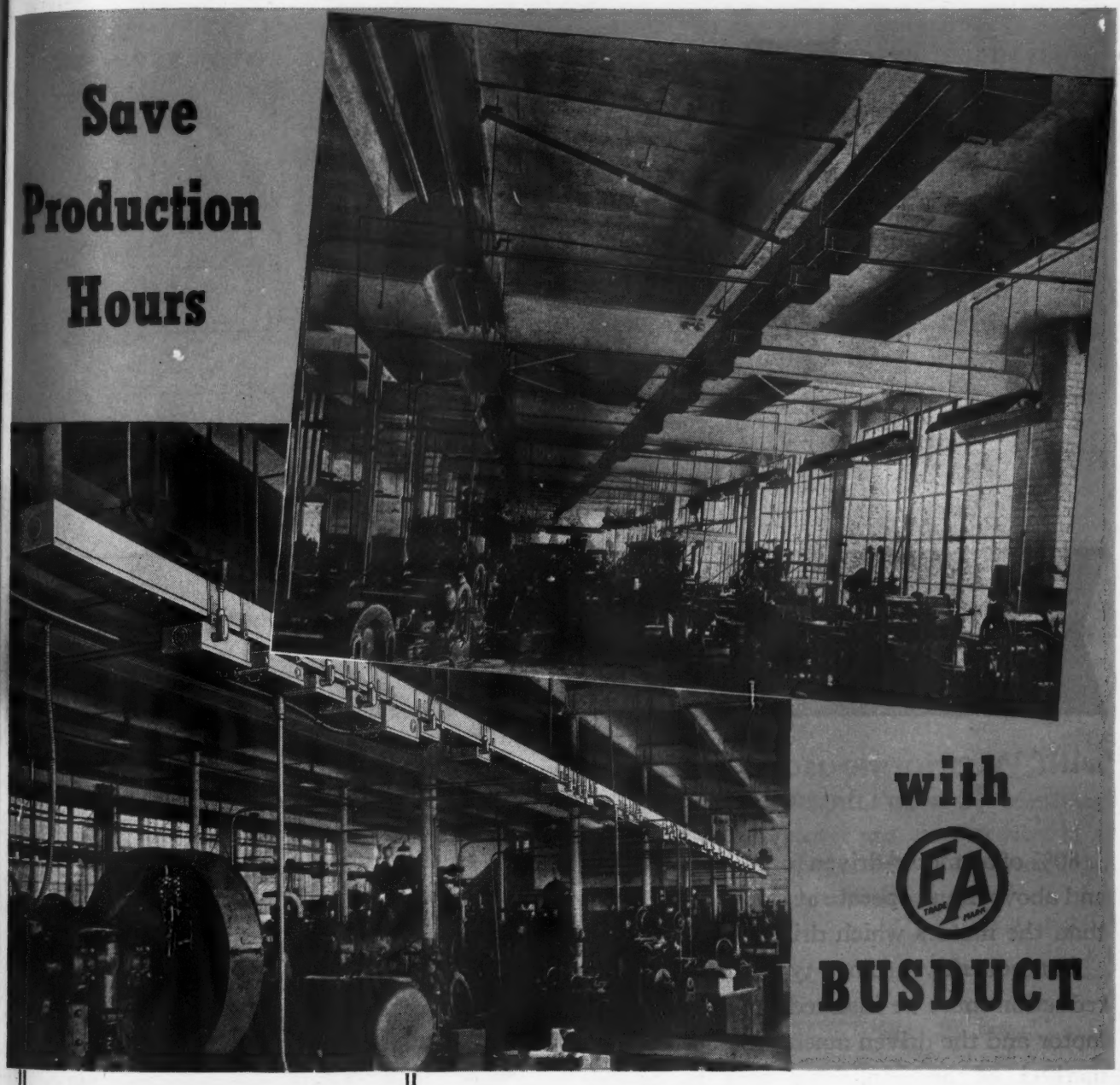
DISINFECTAIRE Units—ready now—and already accepted by the Council of Physical Theraphy of the American Medical Association for hospital use, provide you the means for entering this market. These DISINFECTAIRE Units definitely provide proper shielding efficiency and widespread distribution.

THE ART METAL COMPANY

Manufacturers of Engineered Lighting and Ultraviolet Equipment

1814 EAST 40TH STREET • CLEVELAND 3 • OHIO

Save Production Hours



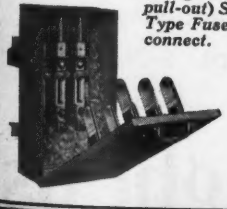
with FA BUSDUCT

FA PLUGIN DEVICES

The FA Plugin Devices can be arranged to go on either or both sides of the Plugin FA Busduct, and each Plugin device is supported by independent fastenings. All FA Plugin Devices are equipped with proper capacity of rugged compression type bus bar connectors. They are made in three types. See illustrations below:

At left: FA Circuit Breaker Type.

Below: FA Klampswitchfuz (hinged type pull-out) Safety Type Fuse Disconnect.



Above: FA Shutlbrak (operating Switch) with Kamklamp Fuse Holders.

This is the *modern* method of light and power distribution . . . Relocation of machines is readily accomplished, with minimum interruption of operating time. Just "move the machine—plug in—go"! . . . If desired, FA Busduct may be taken down and moved to new location—quickly, and without appreciable loss of material . . . Economical for small plants as well as large, this convenient and flexible system (designed for 2, 3 and 4 wire systems, 575 volts AC, maximum) is installed at surprisingly low cost.

The FA Sales-Engineer can help you in planning an efficient and convenient FA Busduct Distribution System. No obligation, of course. Write for name of the one nearest you—and for Bulletin 65 (and supplement) . . . Frank Adam Electric Co., Box 357, St. Louis, Mo.

FA Busducts are now made under W.P.B. Limitation Order L-273. They have the same basic features of construction as the standard model.

Frank Adam
ELECTRIC COMPANY
ST. LOUIS

SOLVE YOUR SPEED REDUCTION PROBLEMS

with Westinghouse Gearmotors

80% of all motor-driven machines, 1 hp and above, must operate at slower speeds than the motors which drive them.

Consequently, some type of speed reduction must be inserted between the motor and the driven machine. The best method of accomplishing this is by the use of Westinghouse Gearmotors which are slow-speed drives with high-speed motor efficiencies.

The product of more than 50 years of gearing experience, these Westinghouse units are designed, built, tested and guaranteed as single units.

Ask your Westinghouse representative about this new, efficient gearmotor. Consult with him about your present speed reduction problems or postwar plans.

Type C — A double-reduction unit for standard ratios from 7.6:1 to 25.7:1, inclusive.

Write for new gearmotor handbook, "Gearmotor Applications". Ask for B-3218. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N.

J-07217

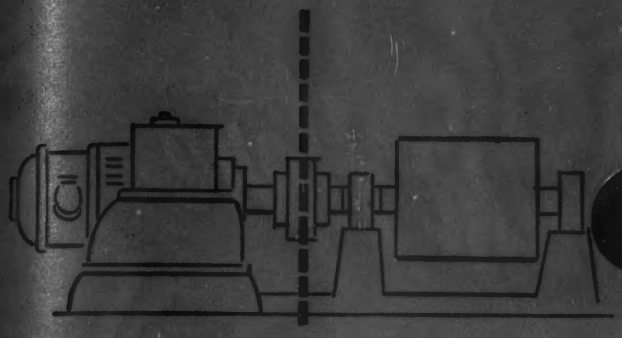
First of a series sponsored by Westinghouse to promote the use of gearmotors.

The New Westinghouse

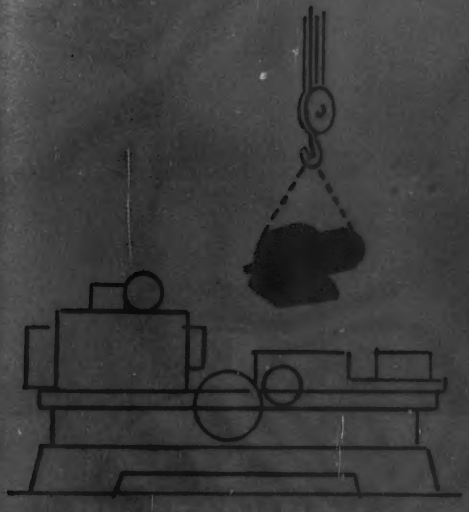
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

A GEARMOTOR IS THE MOST EFFICIENT MEANS OF SPEED REDUCTION

Because it offers:



1 **COMPACTNESS . . .** it takes less space than any other form of parallel shaft speed reduction . . . makes belts, belt guards, pulleys, overhead line shafts *unnecessary*.



2 **LONG LIFE—MINIMUM MAINTENANCE.** A gearmotor has no belts, chains or ropes to replace . . . no multiple-parts to realign . . . no bearings to oil . . . no gears to grease. Probable maintenance consists of a twice-a-year oil change.

3 **EASE OF INSTALLATION.** By combining the prime mover and speed reducer in a single unit, the gearmotor is installed quickly and inexpensively.

4 **HIGH EFFICIENCY.** Only 2% power loss is involved in each stage of reduction . . . a single-reduction unit is 98% efficient; a double-reduction unit is 96% efficient. Compare this with the efficiency of other types of slow-speed drives.

5 **LOW OVER-ALL COST.** The initial installed cost of a gearmotor is usually lower than any other type of speed reduction. On the basis of maintenance and power losses, a gearmotor is *always* most economical.

6 **SAFETY FOR WORKERS.** A gearmotor has no exposed moving parts... no belts, pulleys, chains or ropes to endanger workers. It is totally-enclosed in a streamlined housing.

Gearmotors

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

THE contractor who installed this job gave the best possible protection to his wiring -- rigid steel conduit -- the only system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations.

Many of the installations you have made in wartime are necessarily of an emergency nature. There just isn't enough steel conduit to go around. But the time is not far distant when you will no longer need to depend on makeshift methods and substitute materials.

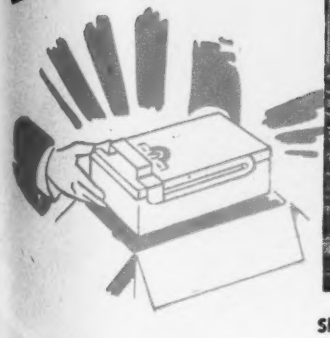
So when you start rewiring those reconversion jobs, as well as installing new systems for new peacetime plants, plan to use dependable Youngstown Buckeye Conduit -- America's standard wiring protection for more than 30 years.

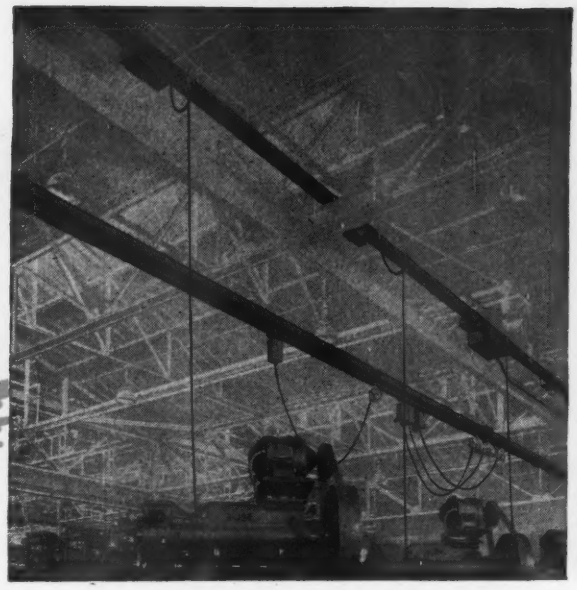
BUCKEYE TRADE MARK YOUNGSTOWN CONDUIT

YOUNGSTOWN
THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO
Manufacturers of
CARBON · ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit . . . Pipe and Tubular Products . . . Sheets . . . Plates . . . Electrolytic Tin Plate . . . Bars . . . Rods . . . Wire . . . Nails . . . Tie Plates and Spikes

"wrap it up.."





"take it away"

Showing above, Flex-A-Power and Flex-A-Plugs to machines. Below, Trolley-Closur to portable tools.

FAMILIAR PHRASES THAT PICTURE

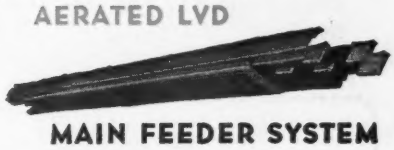
the SIMPLICITY... ECONOMY... SPEED...

of "PACKAGED" POWER DISTRIBUTION *by* TRUMBULL

FLEX-A-POWER

PLUG-IN SYSTEM

AERATED LVD



MAIN FEEDER SYSTEM

"PACKAGED" standardized stock 10′ sections and FLEX-A-PLUGS for distribution of power in secondary circuits and to "point of load" at machines or lighting connections. "A panelboard running the length of the plant". Interconnects with LVD Main Feeder Systems.

"INSTALL-AND-PLUG-IN" speed and convenience for all load connections through COMPLETE series of FLEX-A-PLUGS . . . self-contained protective switching or control units that may be plugged in anywhere along the run at 12" intervals.

LOCALIZED POWER FACTOR correction at point of load provided through CAPACITOR FLEX-A-PLUGS. Also protection against phase failure through visual-indication GROUND DETECTOR FLEX-A-PLUGS.

COMPLETE, BALANCED power service installation with unlimited flexibility for future extension or relocation of machines with ALL needed accessories and time-tested Trumbull Engineering all the way.

"PACKAGED" standardized stock 10′ sections quickly connected and hung overhead, on pillars or against walls to provide in effect "a switchboard running the length of the plant". No time-consuming "special engineering" required.

AMPLE CAPACITY for *present or future* load is assured. Efficiency, safety and performance guaranteed by Trumbull pioneer engineering in this field.

"AERATED" LVD (low voltage drop) . . . full power delivery to point of load. High current-carrying capacity . . . ability to withstand high mechanical and electrical stresses with safety . . . minimum maintenance.

Write for Trumbullaid Bulletin No. 408, which also describes Trolley Closur for supplying power to portable tool.

These systems because of their flexibility, prompt delivery and ease of installation, present great possibilities for use in reconversion of plant equipment.

TRUMBULL

ENCLOSED BUS BAR DISTRIBUTION SYSTEMS

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

❶ Core is made of high grade electrical sheet steel laminations insulated to insure minimum core loss.

❷ Coils are form wound, and thoroughly insulated before being placed in the slots. Coils are securely held in slots by fibre wedges and the ends securely braced to prevent movement.

❸ Frame constructed of welded steel with heavy cross ribs to rigidly support core laminations. Stator is well ventilated, the solid coil shields directing flow of air over coils and exhausted in frame openings.

❹ Field Coils form wound, thoroughly dipped and baked. Coils are well insulated from poles, and fitted fibre washers hold them permanently tight.

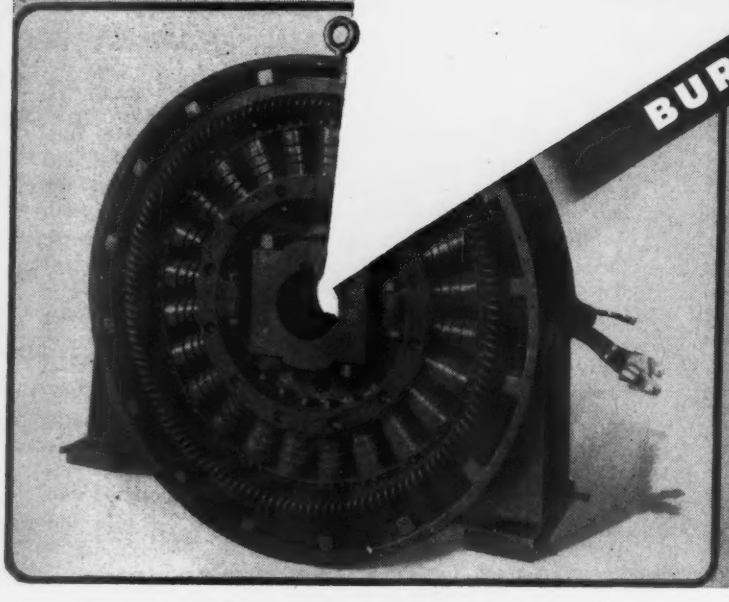
❺ Each Pole Assembly is securely fastened to the Rotor by 2 large studs thru rim and anchored in large rectangular steel rivet insert which serves to hold laminations firmly together.

❻ Rotors are of heavy all steel construction. Rotor made with solid hub, split hub, or can be completely split.

❼ Starting winding embedded in pole face and brazed to end rings which are riveted between poles.

❽ Collector Rings are of bronze with good wearing and conductive properties.

BURKE BUILT IS WELL BUILT



BURKE
SYNCHRONOUS MOTORS AND GENERATORS

TYPICAL of the construction of the larger Burke Synchronous Motors and Generators is that detailed here. Burke as one of the oldest builders of Synchronous equipment, has stressed quality in every detail for over fifty-four years. These motors are built to meet your specifications and are available in all sizes from 1 to 1500 h. p. in belted, direct or engine types either sleeve or ball bearing equipped and with Exciter on top or direct connected. Burke engineers are ready to meet your war demands or to help you prepare for the post war period.

Write today for specific data.

BURKE ELECTRIC COMPANY · ERIE, PA.

SYNCHRONOUS MOTORS AND GENERATORS | INDUCTION MOTORS | D. C. MOTORS | D. C. GENERATORS | M. G. SETS | HIGH SPEED A. C. GENERATOR

MOTORS 1 TO 1500 H. P. · GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA · Since 1901

PRESSURE

BEYOND MEASUREMENT MUST BE WITHSTOOD

Every time a fuse "blows",—the power of excessive current confined in the short strip of fuse metal develops instant and intense heat. Cold metal is transformed into gas—with trip hammer force, pressure deals another blow to the casing of the fuse.

To appreciate the inferno of heat that takes place inside a fuse,—and the pressure that must be withstood is to recognize the importance of definitely specifying Jefferson-Union Renewable Fuses. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ontario.

JEFFERSON ELECTRIC

JEFFERSON UNION
RENEWABLE FUSES

(Here's another ad in the series that brings a vital message to your customers.)

Unwired planning will cost you a whole lot more than planned wiring

Lack of adequate electrical wiring will be expensive in a lot of postwar directions . . . in decreased production efficiency . . . in higher power costs . . . in eventual expense of catching up with competition.

No matter what your postwar plans for conversion, new equipment, plant improvements or new products—you can't take full advantage of any of them without adequate power . . . and that means *adequate wiring.*

Right now is the time to start thinking about the wiring *in your plant.* Bring your consulting engineer and the electrical contractor into your advance planning. Remember . . . electrical power is dead sure to play a constantly increasing role in future production—and wire is the harness. Horsepower—on farm or in factory—is useless without adequate harness.

Let's All Back the Attack
. . . BUY MORE WAR BONDS

ADEQUATE WIRING KEY TO POSTWAR PROSPERITY SERVES AND SAVES

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

Electrical Wires and Cables of Copper are the Life Lines of our Nation

OLD WIRING FOR NEW JOBS

A few weeks ago I visited a plant that construction-wise is still shiny new. It was built in 1941. Today the electrical system is obsolete. And it was obsolete when the plans were drawn. A structure minded architect who looked upon electric work as a minor subcontract, used his iron-clad specification, to assure his customer the very best, and no shenanigans from the contractor whose counsel was neither sought nor welcomed.

In the columns of this journal and in the forums of the industry we read and hear a lot about high intensity lighting, flexible power distribution systems, electronic motor control and all the other facets of modern electrical construction and apparatus development.

Twenty years ago much of this would have seemed utterly fantastic. Twenty years from now I hope much of it will seem crude. But it is elementary that there has been rapid progress in this industry and every sign shows an inevitable continuation in the years to come.

In a stable business like making bricks or running a saloon, it makes little difference to the customer if they carry the same methods and materials through several decades. But it is a matter of vital import to him if we give him a lighting system based on the sound practices of 1933 or a motor and control according to the standard methods of 1928. The excellence of material and workmanship may be there, but with a serious handicap in advanced obsolesence. It means old wiring for new jobs.

Electrical apparatus and systems are well nigh eternal, Under expert maintenance and repair they can be made to last. They become obsolete before they wear out and the tremendous pressure of progress is forcing obsolescence over ever shorter periods. Consequently, up-to-date-ness takes on a critical role in system design and product selection.

Individuals who choose to ignore progress are left behind. They, too, become obsolete. Every plan is a study and every job a challenge in an industry that moves ahead as fast as ours. The contractor, in direct touch with a great variety of electrical work, is in a key position to recognize the trends and counsel those whose responsibility it is to design and specify for the construction that will be done tomorrow. That counsel should be welcomed. And it should be bold. For all the evidence of our industry history indicates that even the best we know today will one day be cast aside as inadequate and obsolete.

Wm. F. Stuart

ELECTRICAL CONTRACTORS:

Here's what the man who will specify and buy for tomorrow's building is reading about you today.

Literally as this morning "John Watts" . . . your electrical contractor . . . may have received that first inkling of some new development in the field of electrical materials or installation. Perhaps it should be incorporated in plans for a "building of tomorrow" you are designing today.

Your key executives, too, may be interested in new devices. Some new materials are proving to be superior to those they have replaced.

Keeping up with the latest developments in the thousands of details which affect building plans is a major task. Your local electrical contractor can render a vital service in keeping you abreast of tomorrow's electrical materials and processes.

Before you reach a final decision on any detail which calls for electrical supplies, equipment or wiring, talk it over with a qualified electrical contractor. The chances are he is keeping fully informed with the help of his GRAYBAR Man. 3529

Give Your Electrical Work to "John Watts"

a qualified electrical contractor—heading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronics. From offices and warehouses in over 80 cities, GRAYBAR serves a nation of JOHN WATTS, helping them to help you by supplying the newest and best in electrical materials.

This GRAYBAR advertisement . . . appearing in the June issue of *Architectural Forum* . . . tells the electrical contractors' story to some 40,000 architects and other leaders in the building industry. It urges them to use your services to their advantage . . . and your profit . . . now, and in the future.

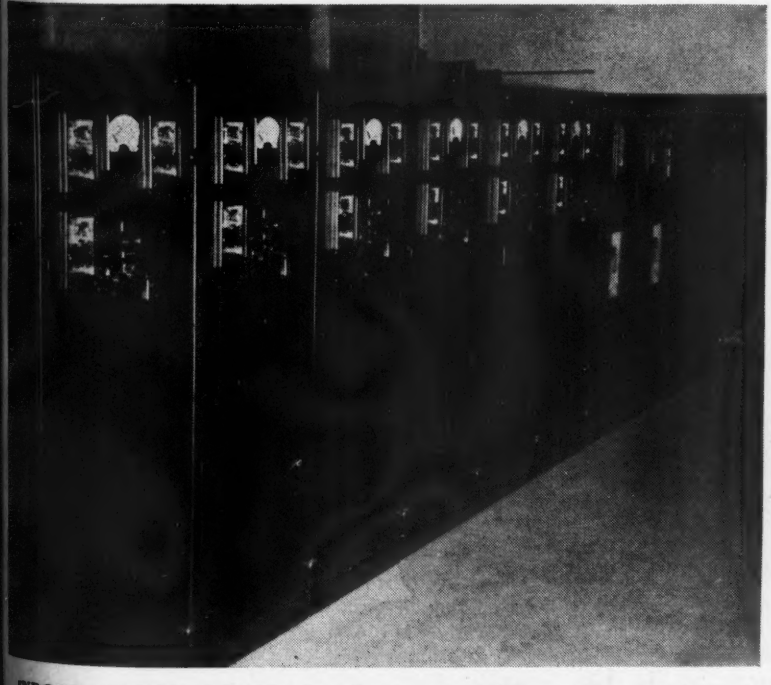
To help you do a good job, you will find your local GRAYBAR Man ready with up-to-the-minute information and electrical supplies. 3533

High Voltage for GUN MAKING

Electrical distribution at York Safe and Lock war plant is carried at high voltages to load centers.

By
Robert E. Miller

NORMAN E. ABEL, York, Pa., electrical contractor who designed and installed the 13.2 kv. load-center distribution at the York Safe and Lock Company's Special Ordnance Plant.

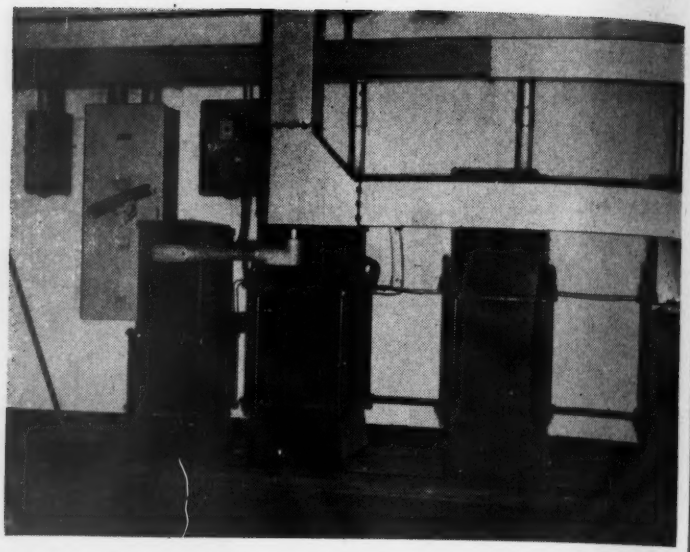


INDOOR HIGH-VOLTAGE distribution switchgear. From left to right, the first six cubicles control the outgoing feeders; the next two contain the metering equipment, the current and potential transformers, etc.; and the last two cubicles contain the incoming line breakers.

STREAMLINED buildings of the York Safe and Lock Company Special Ordnance Plant rise out of a landscaped countryside. Lush green lawns and cozy flower beds give no hint of the industrial activity inside. But Bofor guns from York S.O.P. are today protecting shipping all over the world. And a tough war job is being done with the help of a streamlined and efficient high voltage power and lighting distribution system. Norman E. Abel, electrical contractor of York, Pa., and the head of I. B. Abel-Son, Inc., designed the electrical system and made the installation.

Electrical Distribution

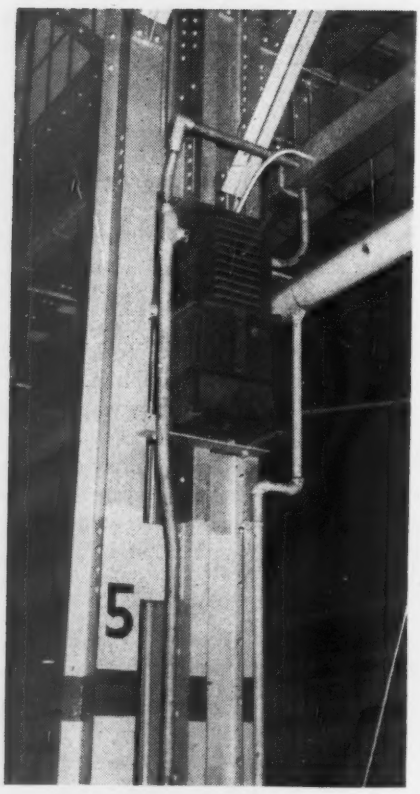
The York S.O.P. takes power from utility lines at 13,200 volts, 60 cycles, 3 phase, 3 wire into its own outdoor bus structure of wood-pole construction. Parallel feeders drop from the high-tension overhead bus through fused disconnects. Individual potheads cemented onto the six Okonite cable feeders (500,000 CM) carry the power



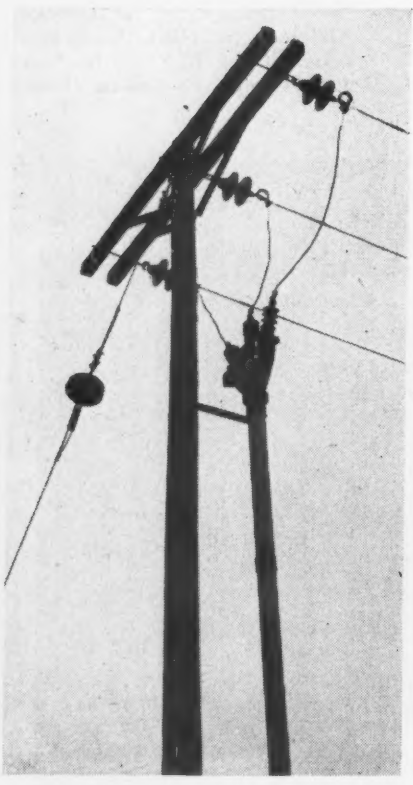
ADMINISTRATION BUILDING lighting is supplied by three 50 kva. dry-type transformers 440 to 120/208 three phase, four wire. Smaller transformer on left supplies 110/220 volts for special application. Note the ring of grounding bus which is connected to the driven grounds behind the transformers.

LEFT

HEAVY BUS STRUCTURE in center is the 2000 ampere tie-bus connecting the three main switchboards. Note the square duct feeding longitudinally down the side bay beneath the tie-bus. Conduit risers on the right carry feeders laterally across the plant to the square ducts of successive bays. Square blurred box in center is the switchboard ground detector.



LIGHTING TRANSFORMERS on the building columns are rated 25 kva. at 440 to 110/220 volts. Secondary leads go directly to square duct and continue down to next column where panel is located.



AT THE CORNER of the main plant, a six inch conduit riser brings the proving-ground 13.2 kv. feeder from underground to overhead. The 3 conductors emerge from conduit in three-bushing potheads.

underground in two 6-inch conduits to the distribution switchboard. Where the cables enter the conduit in the outdoor station, wood plugs and compound seal out moisture and foreign matter.

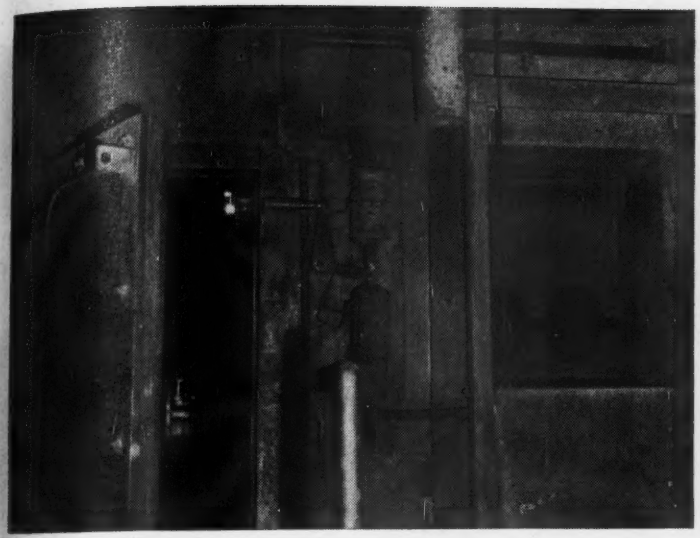
Distribution to Load Centers

The indoor switching station is composed of a ten cubicle, unit-ized, draw-out type switchgear. Two cubicles are used for the main incoming line breakers; two are used for meter and relay equipment; and six contain the switchgear for the six separate 13.2 kv. distribution circuits. Buried in concrete envelopes, 4½-inch fiber ducts carry the 3 conductor No. 2–13.2 kv. cables to the various outdoor load center transformers.

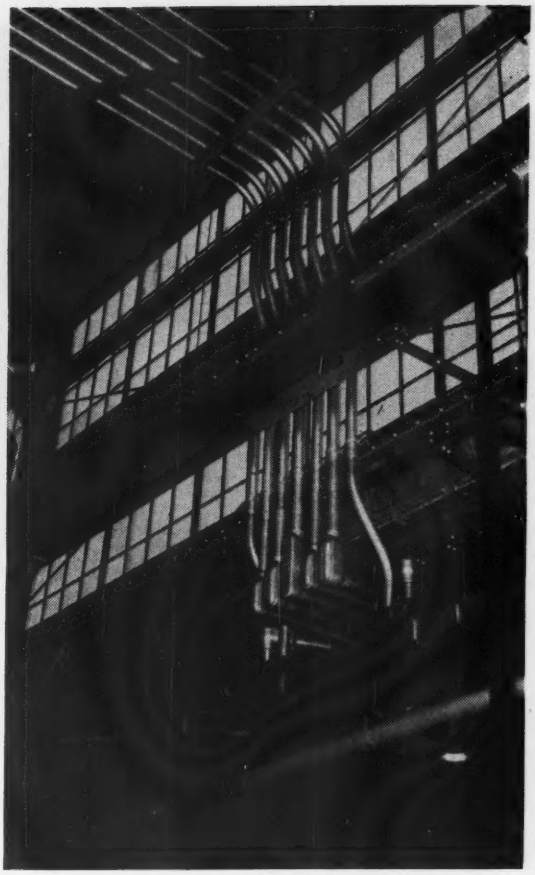
Thick concrete walls surround each outdoor transformer bank to prevent sabotage to the tanks. The conductors are brought up from underground through tri-bushing potheads and onto the primary bus which is hung from overhead steel structure. All equipment in the substation is connected to the ring of ground bus tied to the driven ground at each station.

Branch Feeders

The 440-volt, 3 phase, 3 wire secondary bus is taken directly through the



THIS PICTURE taken from inside the firing tunnel, shows the safety interlock between the tunnel door and gun-barrel door. Tunnel door must be closed to operate limit switch which in turn operates solenoid to shoot bolt. Barrel doors may then be opened. Note pushbutton by door, permitting a person caught in the tunnel, to let himself out.



RIGHT

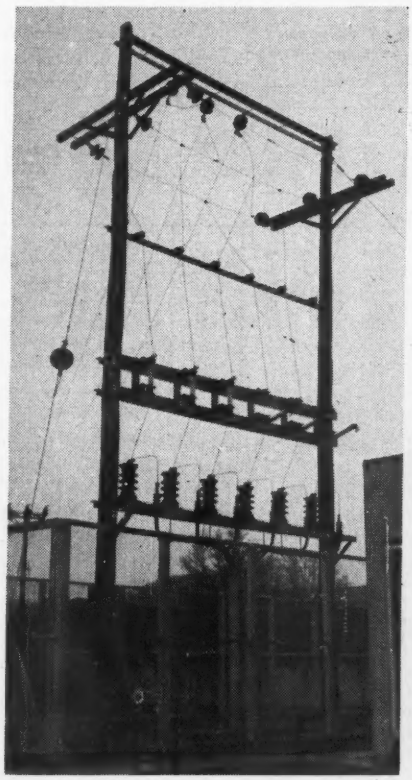
CONDUIT RISES from a low side-bay to span one of the high crane-bay areas. Note how the two outside feeders carry cables through two connection boxes in the square duct runway. Channel iron hangers from long suspension bolts carry the conduit load. Hot-dipped galvanized conduit is used throughout.

building wall to the secondary distribution switchgear. In the main building, the three outdoor substations of 1500 kva. each situated at the approximate load centers are located at the side of, and in a straight line down the length of the building. The substations are designated A. B, and C, and feed across the width of building.

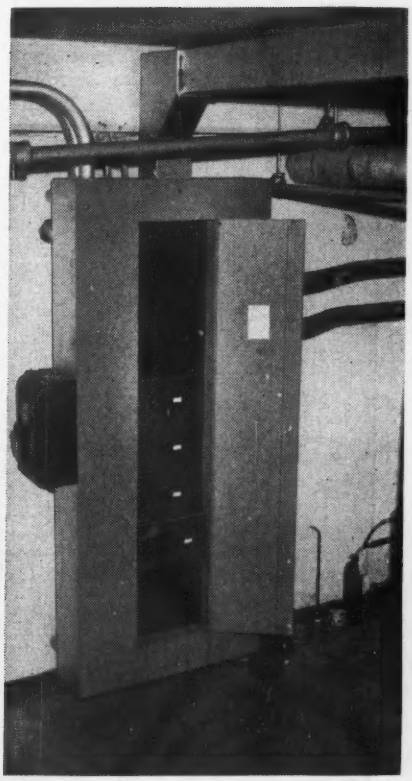
Tie Busses

Metal enclosed 2000 ampere bus connects the secondary switching cubicles. The center switchboard "B" contains a sectionalizing breaker at either end; one connecting the tie-bus to "A" switchboard and the other connecting the tie-bus to "C" switchboard. Under normal operation, the sectionalizing breakers are open with each switchboard supplied by its own transformers. The tie-busses are hot, however, up to the center panel "B", for they are tied-in solid to the switchboard busses of "A" and "C" panels respectively. In the event of an emergency, any combination or all three panels can feed from any single transformer bank or combination of banks.

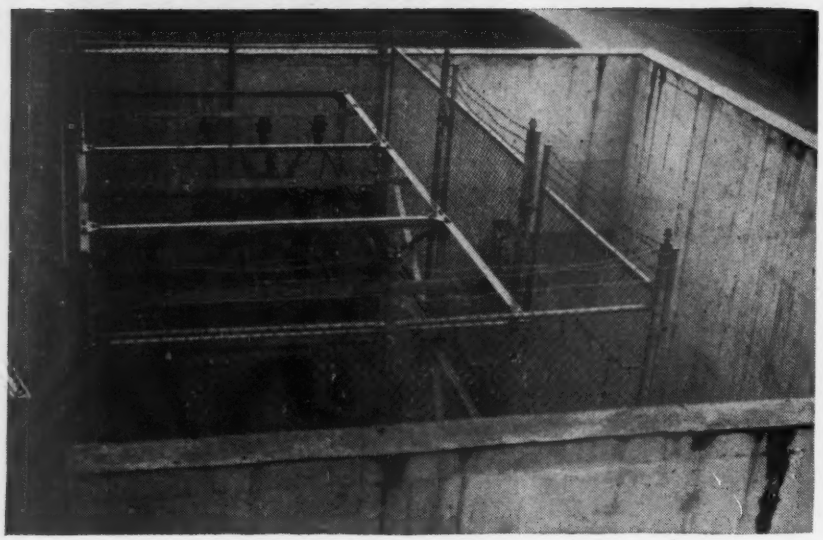
The 440-volt feeders leaving the panels are carried in rigid conduits laterally across the building area to the six inch square duct raceways which



TWO PARALLEL FEEDERS drop from the station bus through fused disconnects, onto the lightning arresters and to individual cable potheads. Two conduits carry six cables to indoor distribution switchgear.



LIGHTING PANEL and distribution board for administration building circuits is located across the room from the transformers and connected by square duct. Thermally protected breakers are used.



CONCRETE WALL ENCLOSES each substation. This is one of the main subs containing three 500 kva. transformers. Note three-bushing pothead and 13.2 kv. connections to the high voltage bus.

feed longitudinally down successive bays. Each bay is provided with a raceway on each side to carry both lighting and power feeders.

All magnetic circuit breakers, switches, lighting panels and the like are identified both with the particular feeder and the main distribution panel by stenciling. For instance, PFB4 on a magnetic circuit breaker would mean that it is a power feeder supplied from No. 4 breaker on "B" board. LFA6 would mean the switch or panel was fed from a lighting feeder from breaker No. 6 on "A" board. In the event of "no-power" or trouble of any kind at a distribution point, operators or trouble-shooters can quickly identify circuits.

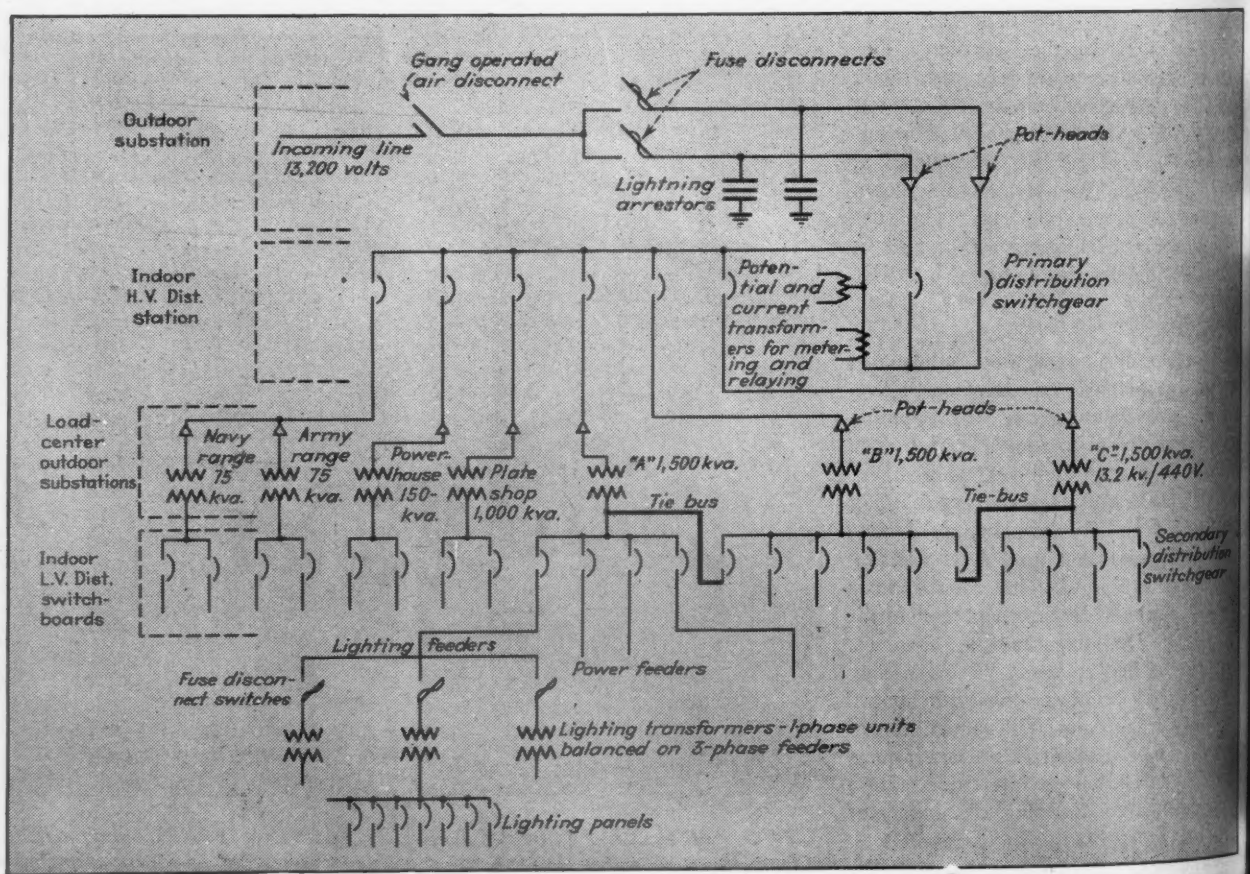
Lighting Circuits

Plant lighting is exclusively incandescent using both steel enameled and glass prismatic reflectors. Lighting circuits are supplied from 440 to 110/220 volt dry type transformers, each 25 kva. and hung at lighting load centers on the building columns.

Taps are made to the 440 volt lighting feeders in the square duct raceway. Rigid conduit carries the lighting transformer primary wires down the building column, through a magnetic circuit breaker, and back up to the transformer primary terminals. The 110/220 volt secondary then drops to the 28 circuit lighting panels which are generally mounted on the same column. Branch circuit breakers are of the no-fuse automatic trip-free type. The various branch circuits are carried in conduit back up to the square duct for distribution to fixtures.

To supply the lighting for the administration building, a 300 MCM three phase, 440-volt feeder is brought

[Continued on page 82]



SINGLE-LINE DIAGRAM of the electrical distribution. All feeders leave the primary distribution switchgear in 4½-inch fiber ducts buried in underground concrete envelopes. Feeders are brought up within the concrete-enclosed substations in three-bushing potheads and onto the primary station bus. Note secondary tie-bus between stations "A" and "B", and "B" and "C" and the tie-bus breakers in panel B.

DRILL REPAIR DEPARTMENT showing drill repair desks (in foreground) where girls check, test and repair drills. Armature and coil winding (in background) where girls replenish stock supply of armatures and coils for quick repair.

Portable ELECTRIC TOOL Maintenance

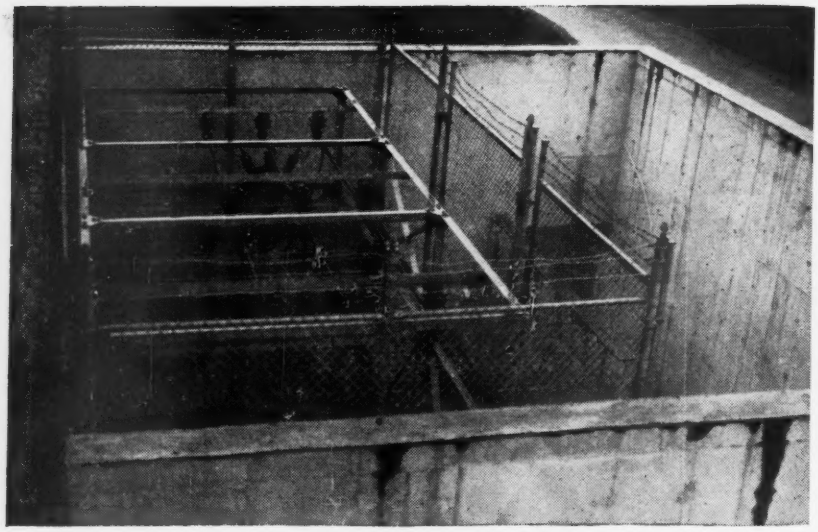
A DAY'S WORK begins as a portion of the daily batch of from 450 to 500 portable electric drills come up from the assembly floor for service.

The application of mass production methods to electric tool maintenance keeps 10,000 portable electric drills in A-1 condition at Consolidated Vultees

By August Eckel

UNLESS one has had the opportunity of seeing a modern bomber or transport plane take shape, it is difficult to picture the tremendous amount of detailed hand work that is necessary. Hundreds of thousands of tiny holes are drilled into the aluminum "skin" and structural members of a modern plane by thousands of workers using portable electric drills that receive plenty of rough usage and punishment and require constant repair.

That is the picture at Consolidated Vultee Aircraft Corporation's Fort Worth, Texas plant where, day and night, Liberators roll off the world's longest straight mechanized assembly line. With approximately 10,000 universal type, 110-volt, 60 cycle, portable electric drills in use—485 of which required some sort of attention each day—Consolidated's electrical maintenance department faced a serious problem. How to take care of the demand which reached these proportions primarily because present day employees are not



***CONCRETE WALL ENCLOSES** each substation. This is one of the main subs containing three 500 kva. transformers. Note three-bushing pothead and 13.2 kv. connections to the high voltage bus.*

feed longitudinally down successive bays. Each bay is provided with a raceway on each side to carry both lighting and power feeders.

All magnetic circuit breakers, switches, lighting panels and the like are identified both with the particular feeder and the main distribution panel by stenciling. For instance, PFB4 on a magnetic circuit breaker would mean that it is a power feeder supplied from No. 4 breaker on "B" board. LFA6 would mean the switch or panel was fed from a lighting feeder from breaker No. 6 on "A" board. In the event of "no-power" or trouble of any kind at a distribution point, operators or trouble-shooters can quickly identify circuits.

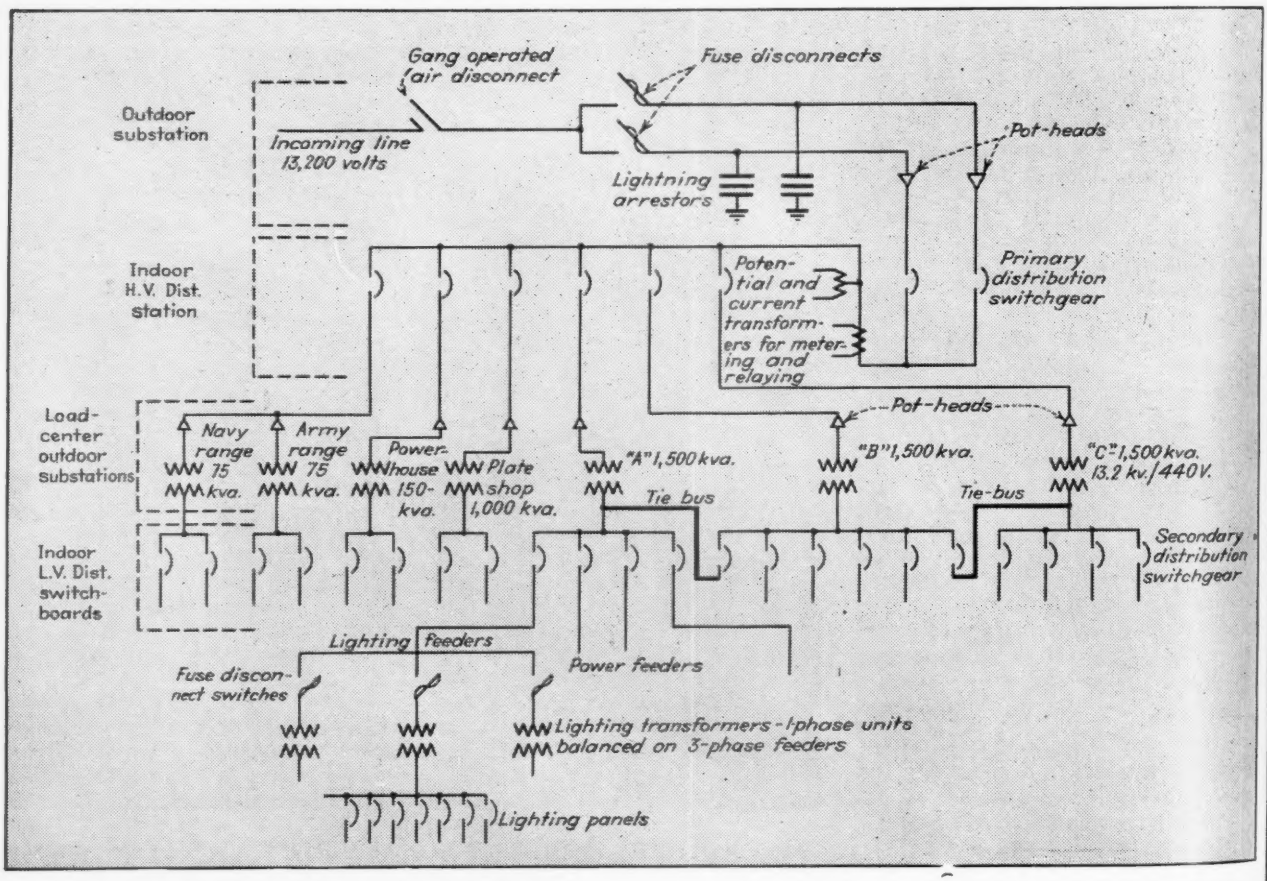
Lighting Circuits

Plant lighting is exclusively incandescent using both steel enameled and glass prismatic reflectors. Lighting circuits are supplied from 440 to 110/220 volt dry type transformers, each 25 kva. and hung at lighting load centers on the building columns.

Taps are made to the 440 volt lighting feeders in the square duct raceway. Rigid conduit carries the lighting transformer primary wires down the building column, through a magnetic circuit breaker, and back up to the transformer primary terminals. The 110/220 volt secondary then drops to the 28 circuit lighting panels which are generally mounted on the same column. Branch circuit breakers are of the no-fuse automatic trip-free type. The various branch circuits are carried in conduit back up to the square duct for distribution to fixtures.

To supply the lighting for the administration building, a 300 MCM three phase, 440-volt feeder is brought

[Continued on page 82]



***SINGLE-LINE DIAGRAM** of the electrical distribution. All feeders leave the primary distribution switchgear in 4½-inch fiber ducts buried in underground concrete envelopes. Feeders are brought up within the concrete-enclosed substations in three-bushing potheads and onto the primary station bus. Note secondary tie-bus between stations "A" and "B", and "B" and "C" and the tie-bus breakers in panel B.*

***DRILL REPAIR DEPARTMENT** showing drill repair desks (in foreground) where girls check, test and repair drills. Armature and coil winding (in background) where girls replenish stock supply of armatures and coils for quick repair.*

Portable ELECTRIC TOOL Maintenance

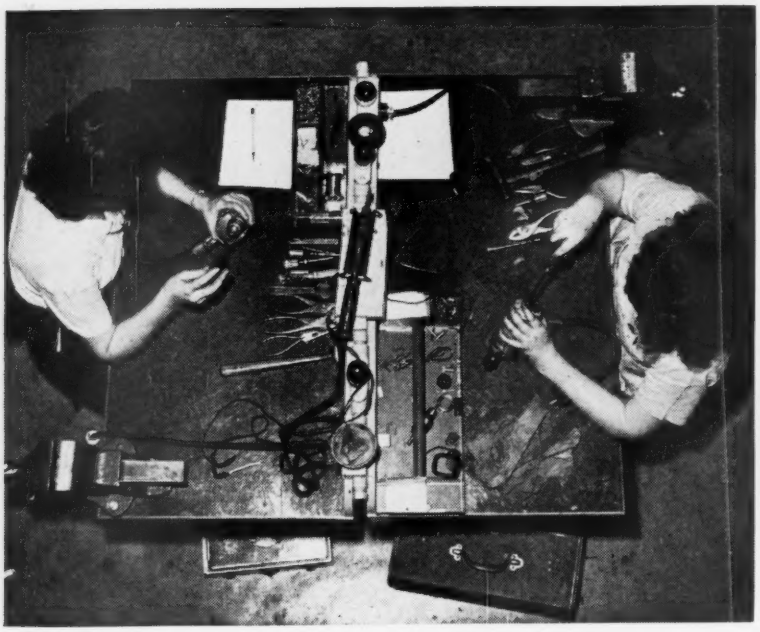
***A DAY'S WORK** begins as a portion of the daily batch of from 450 to 500 portable electric drills come up from the assembly floor for service.*

The application of mass production methods to electric tool maintenance keeps 10,000 portable electric drills in A-1 condition at Consolidated Vultees

By August Eckel

UNLESS one has had the opportunity of seeing a modern bomber or transport plane take shape, it is difficult to picture the tremendous amount of detailed hand work that is necessary. Hundreds of thousands of tiny holes are drilled into the aluminum "skin" and structural members of a modern plane by thousands of workers using portable electric drills that receive plenty of rough usage and punishment and require constant repair.

That is the picture at Consolidated Vultee Aircraft Corporation's Fort Worth, Texas plant where, day and night, Liberators roll off the world's longest straight mechanized assembly line. With approximately 10,000 universal type, 110-volt, 60 cycle, portable electric drills in use—485 of which required some sort of attention each day—Consolidated's electrical maintenance department faced a serious problem. How to take care of the demand which reached these proportions primarily because present day employees are not



***REPAIR DESK EQUIPMENT** includes test outlets backed up by a 3-ampere fuse in switch, a vise, soldering iron, complement of hand tools, spare parts tray and work reports.*

***ARMATURE STRIPPING** is accomplished by first cutting side of coils on lathe, then pulling them out from the other end.*

accustomed to using or caring for electrical tools? Local motor repair shops and even manufacturers were unable to keep up the pace and couldn't even make a dent in the repair demands. The only answer was for Consolidated to set up its own repair department—which it did.

The electrical maintenance department—which covers all electrical maintenance—occupies a section of a mezzanine which provides ample room for an orderly and efficient arrangement of equipment. Here the electrical maintenance foreman holds forth with three crews totalling 110 employees and divided as follows: one assistant foreman in charge of 86 girls (primarily on drill repairs) 46 on the day shift and 40 on the night shift. A second assistant foreman has charge of 22 men (six of whom are on the night shift) divided into a motor maintenance group of 17 and a motor control group of five.

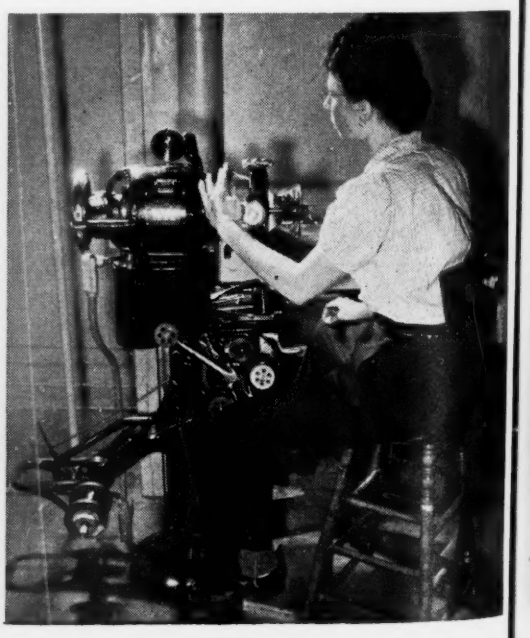
The electric drill repair section is divided into the following functional groups:

1. Drill repairs—There are twelve double desks with two girls working at each
2. Armature and stator stripping
3. Armature and coil winding
4. Dipping and baking (also used for other motor repairs)
5. Aluminum case welding
6. Extension cord repairs
7. Final testing and color coding
8. Spare parts stock

Drill maintenance is so scheduled that each unit receives a check-up approximately twice a month. Duplicate

***A CLEANSING BATH** is given drills in this double wash tank equipped with drain boards and a compressed air nozzle for quick drying.*

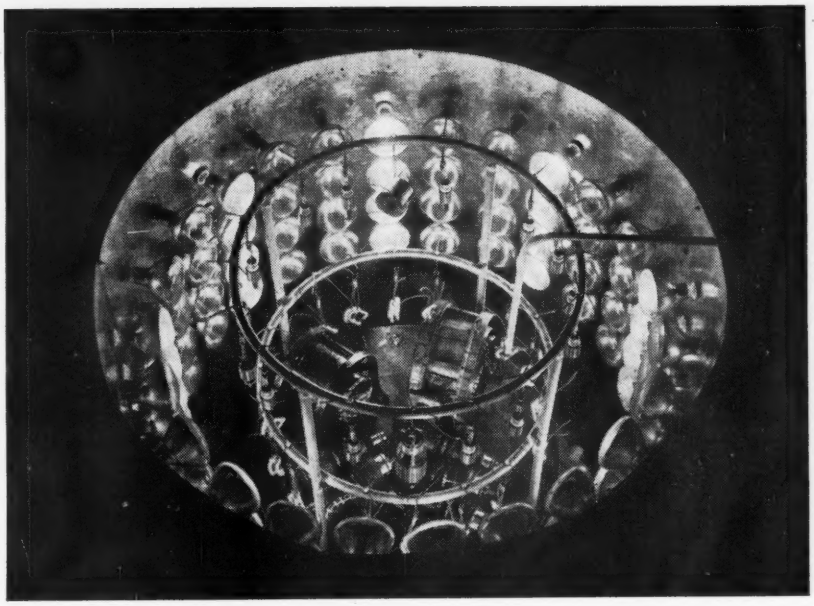
***A TRAINED WINDER** can turn out from 80 to 100 armatures per day on this machine. Units are connected, dipped and baked.*



checking is eliminated by using a color code. Drills serviced during the first half of the month have their end bells painted with a colored quick-drying enamel; those serviced during the last half of the month receive a different colored enamel. With a total of 10 colors in use, this coding lasts for five months when the series is repeated.

When drills with an expiring color code are up for inspection, they are gathered up—one assembly section at a time—during the lunch period and replaced with newly repaired units by the tool crib crews. Units that break down in the interim period are taken to the tool crib and replaced with a good one. All collected drills are placed in large boxes and taken to the electrical maintenance department by the electric truck of the interplant transportation system.

The electric drill repair department operates primarily on a parts replacement principle. Drills do not lie around awaiting the rewinding of armatures or coils or other repairs, but are immediately fitted with new or rebuilt parts and put back into service in the shortest possible time. This is the function of the drill repair group. The groups concerned with stripping, winding, dipping and baking armatures and coils work only on items that are to replenish the stock of replacement parts used in servicing the day's lot of drills.



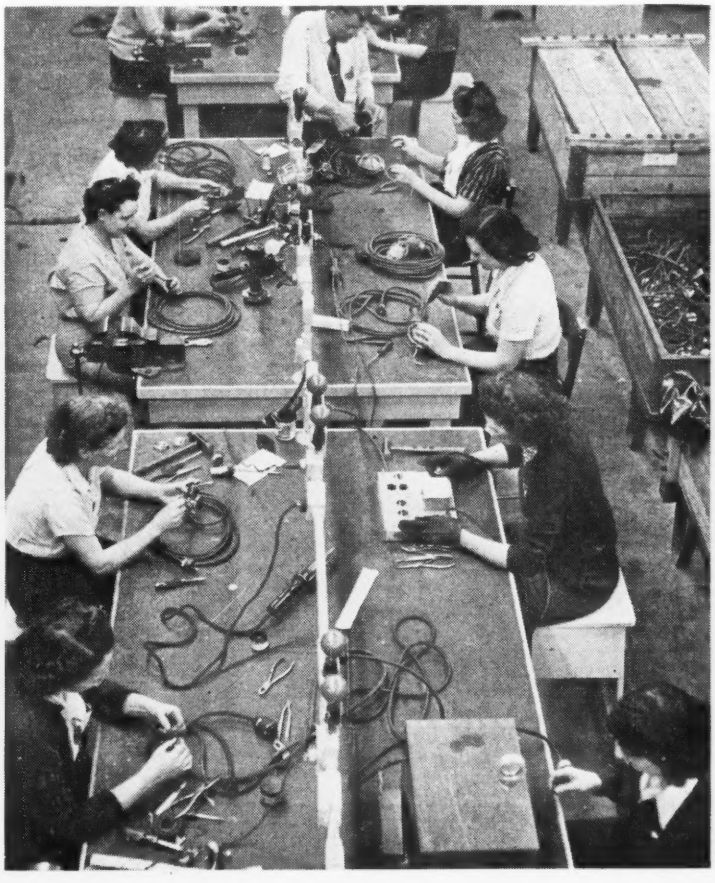
***INFRA-RED TANK** bakes drill armatures and other motor equipment in two hours as platform with superstructure slowly rotates within the circle of lamps.*

If an emergency drill job comes in and the spare parts are available, a completely rebuilt unit can be turned out in about 20–30 minutes. If no spare parts are available, but all materials are on hand a drill could be completely rewound and repaired in four hours—two of which were for baking in an infra-red oven. Each girl on the repair desks averages approximately 12 repaired drills per 8-hour day; sometimes one turns out 16 if the repairs are less time consuming.

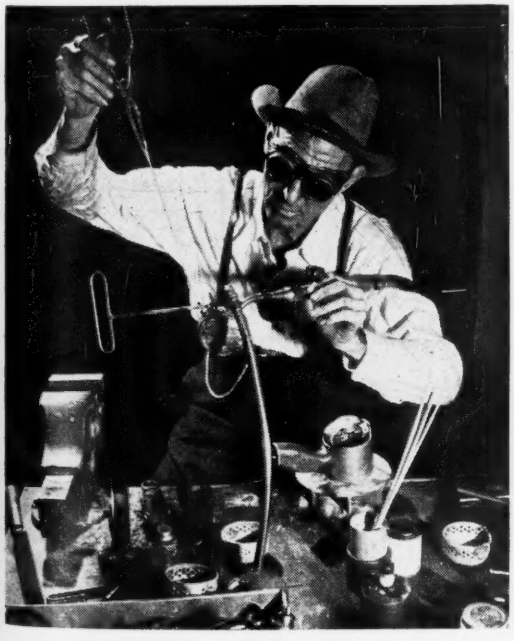
Under normal operating procedure girls at the repair desks take drills from the incoming boxes as they turn over their repaired unit to the final test bench located near the incoming and

Continued on page 172)

***CORD REPAIR DEPARTMENT** where extension cords and drop lights are rehabilitated. Woman in extreme lower right of photo is using an electronic device which indicates hidden breaks in cords.*



***DRILL CASE SALVAGE** is an important item to the maintenance department. Here an aluminum welder rescues one from the junk pile and prepares it for the spare stock shelves.*



Estimating
CUBICLE SWITCHGEAR WORK

An evaluation of factors to be considered when figuring cubicle switchgear installations—particularly on water treatment and control projects where difficult transportation problems arise. Attendant labor data is based on actual installation experience.

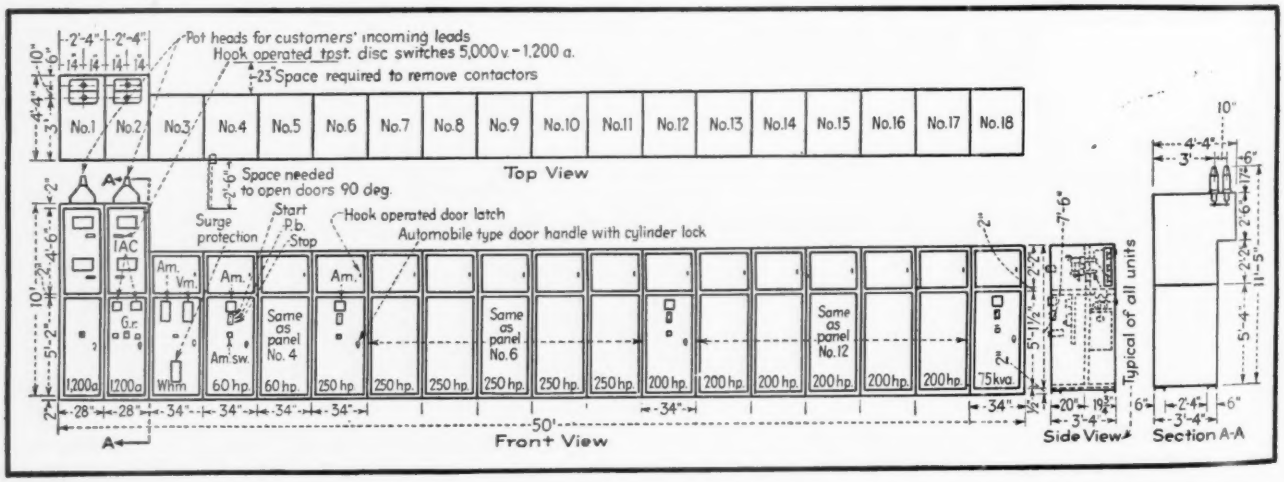
THE advent of peace will loose an avalanche of electrical modernization and new construction—both private and public—that has been steadily pyramiding during the war years. The government sponsored flood control program, nipped in the bud by the war, will probably be resumed. Water pumping and filtration plants, sewage disposal plants, industrial and commercial electrical modernization—all installations in which latest electrical equipment design presages the use of cubicle switchgear and control equipment—will be part of a vast postwar program.

Contractors who previously have been accustomed to installing complete switchboards as a unit, or the field-fabricated built-up type will be faced with new problems in estimating. Unless they are on their toes they will discover by bitter experience that after the job has been completed they "forgot something".

What are a few of the "somethings" that can be easily overlooked when estimating cubicle switchgear work? Let's take for example, an installation in a water treatment plant—generally located some miles distant from the nearest freight depot or transportation center and hence posing the most difficult problems that may be encountered.

Before the contractor ever sits down to his estimating pad he must consider the following factors:

1. *Physical Size and Weight* of the complete cubicle type board. This will definitely influence the installation technique he develops and the shipping orders he will give the manufacturer. Equipment manufacturers' catalogs and quotations give this data. A single, reduced voltage, oil filled motor starter cubicle normally weighs from 900 to 1200 pounds crated—excluding the oil—and will have physical dimensions approximately 7-ft. high, 2-ft. wide and 3-ft. deep. Thus a five cubicle board will weigh about 5,000 pounds and be about 10 feet long.
2. *Job Site Conditions* should be carefully studied with particular emphasis on facilities for getting the equipment into the building. The possible condition of the grounds surrounding the building (hard or soft ground, obstructions, etc.) when the board is to be delivered (summer or winter) is another important consideration. These two factors will determine, to a large extent, the number of sections in which the equipment is to be shipped, and the amount of labor to delegate for moving the board into the building.
3. *Transportation Facilities* from the freight depot to the job site should be investigated while determining the job conditions. Size of trucks available and distance from depot will influence the degree of sectionalization of the equipment and overall cartage cost.
4. *Degree of Sectionalization* of the equipment, as determined by the above factors, will have a direct bearing on the amount of labor required to unload the board, move it in the building and assemble it. Shipping instructions are also based on this factor.
5. *Shipping Instructions* to the manu-



CUBICLE TYPE SWITCHBOARD, installed in a water filtration plant, to which the labor units in the table apply. Board contains two 2300-volt service units, one surge protection unit, and 15 motor control units.

By
Leo W. Witz
Continental Electrical Construction Co.
Chicago, Illinois

facturer must be clear and concise, particularly to sectionalization of equipment to fit the job conditions. "F.O.B. Factory—freight allowed to point of shipment" should not be confused with "Freight allowed to job." This should be clearly understood and the proper instruction given, for someone must pay for delivery to the job. If the price is quoted "F.O.B. Factory" make a sufficient allowance in the estimate to cover delivery cost.

6. *Construction Sequence* is an important consideration particularly in "water treatment" projects where the general contractor frequently does the outside work first and leaves the building proper as a "fill-in" proposition. This usually means the equipment arrives before the building is ready. If this happens, an economical method of storing the board is to build a platform, at truck level to support it (at some distance from the building to prevent damage) until it is moved into the building. This eliminates the job of lowering the unit from the delivery truck and hoisting it on another truck for cartage to the building when ready.

Another serious consideration, on out of town jobs, is the maintenance of a job foreman at company expense when he can neither return home nor work productively due to the intermittent construction.

7. *Incidental Installation Work* covers a number of items that easily can be overlooked but which run into considerable labor as can be seen from the attendant labor data table. Among them are:

A. Aligning conduits under the board—this must be done accurately for, once imbedded in concrete, they can't be shifted. Measurements must be "on the nose". It required 32 man-hours to spot the elbows; layout, make, install and brace a wood template for the 18-cubicle board described later.

[Continued on page 168]

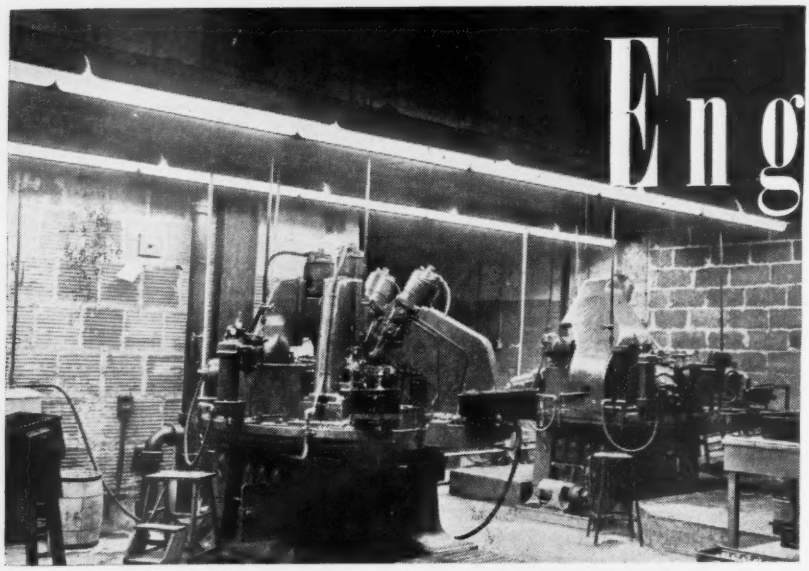
LABOR DATA FOR INSTALLING CUBICLE SWITCHGEAR
(18-cubicle, 2300-volt, board)*

Item No.	Description of Work	Man-hours per unit	Man-hours Total
1.	**FLOOR CHANNELS** — includes positioning and anchoring two 50-ft., 2 in. by 6 in. channels.		
	Moving four 20-ft. sections into bldg.	1.2	4.8
	Moving two 10-ft. sections into bldg.	0.6	1.2
	Layout, dimension and spot bolts		4.0
	Anchor channels with ¾ in. by 4 in. bolts (used air hammer)		10.0
	Total for channel work		20.0
2.	**SET MOTOR CONTROL CUBICLES** — includes rolling in, uncrating and setting on channels.		
	Six 2-cubicle sections — (6 men required)		
	Roll in units	8.0	48.0
	Uncrate, remove hoisting channels	2.0	12.0
	Set units on floor channels (used rolls)	2.0	12.0
	One 3-cubicle section		
	Roll in unit		9.0
	Uncrate, remove hoisting channels		3.0
	Set unit on floor channels (used rolls)		4.0
	Total (from outside building to position on channels)		88.0
3.	**SET SERVICE CUBICLES** — same operations as for motor cubicles.		
	Bottom section — (six men required)		18.0
	Top Section — (six men plus extensive rigging required)		26.0
	Total (from outside of building to position on channels)		44.0
4.	**LEVEL THE BOARD** — included leveling, shimming and lining up entire 50-ft. length of board for bolt type cubicle joints. (jacks and crowbars used)		
	Total Labor		24.0
5.	**BOLT SECTIONS TOGETHER** — includes bolting together the open sides, front and back, of 8 sections — required 7 bolting jobs.	8.0	56.0
6.	**BOLT TOP SERVICE SECTIONS** — includes bolting top sections of service cubicles to lower sections.		6.0
7.	**BUS CONNECTIONS** — Motor Control Cubicles — Bus had to be connected in 15 units	3.6	54.0
8.	**BUS INSTALLATION** — Service Cubicles — bus came knocked-down — had to install about 30 sections, connect, tape and paint with insulating varnish.		42.0
9.	**GROUND BUS CONNECTIONS** — included bolting and fastening cubicle small grounding bus (installed at factory) in seven places		7.0
10.	**INSTALL BARRIERS** and fuses in disconnect switch compartments of cubicles		
	Install 60 barriers (four per cubicle)	0.25	15.0
	Fit and install 45 fuses (three per cubicle)	0.50	22.5
	Total		37.5
11.	**FILL OIL SWITCH TANKS** — included pouring oil into 17 tanks — (2 men required)	3.0	51.0
T	**TOTAL LABOR FOR CUBICLE BOARD INSTALLATION** — does not include conduit terminals, cable connections, cartage, etc.		429.5

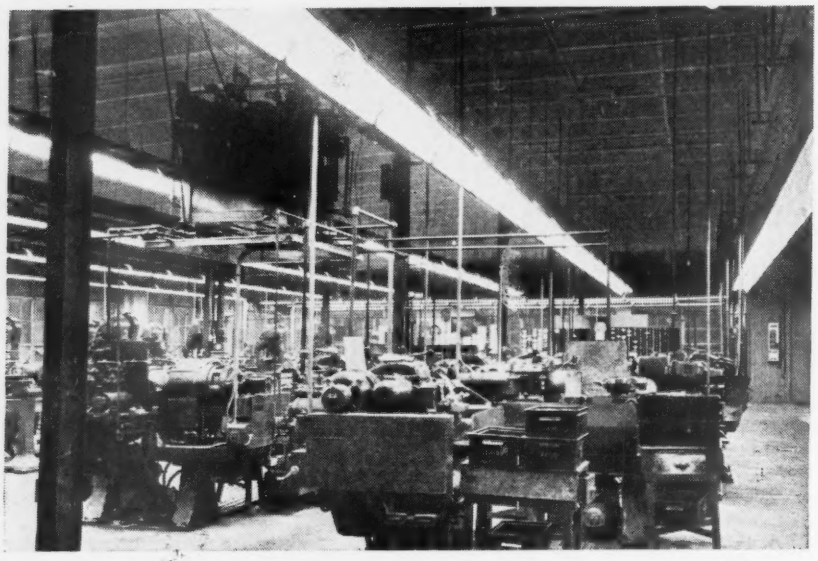
*Note: The above labor units are for cubicles with 2300-volt, across-the-line equipment. Cubicles with reduced-voltage equipment would weigh more and the labor units for setting might vary slightly from those recorded here.

Engineered

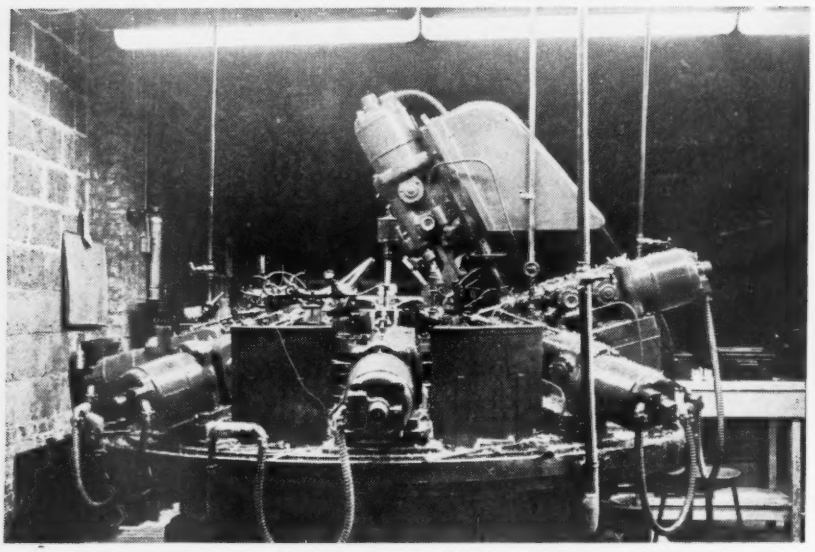
Step-by-step plant relighting builds



INITIAL INSTALLATION of continuous row fluorescent lighting in the Kingsbury department was the forerunner of the project.



SHAFTS OF LIGHT blanket the working plane in this turret lathe department with 60 foot-candles of evenly distributed illumination.



WORKING PLANE on the Kingsbury multiple spindle drilling machine receives 60 foot-candles of shadowless light.

WHILE canopies of aircraft protect our invasion forces on the battle-fronts, canopies of light protect our production forces on the home front. What good lighting has accomplished in our modern war plants can also be accomplished in the thousands of small subcontracting plants throughout the country.

The Milwaukee Gas Specialty Company presents an outstanding example of an engineered relighting project. It all started when the company installed three Kingsbury multiple spindle drilling machines in one of their plants manufacturing timing fuses for the armed forces. General plant lighting was in the order of 18 to 20 foot-candles provided by 200-watt incandescent RLM units, mounted nine feet above the floor on an 8-ft. by 9-ft. spacing. Operators had to see down into the machine and the rather spotty and shadow-infested incandescent lighting was totally inadequate.

Gogan Electric Co., electrical contractor, was called in for remedial suggestions. After recommending fluorescent fixtures over individual machines, he consulted Earl H. Aik, Milwaukee lighting engineer. The outcome of the consultation was the recommendation—and installation—of two continuous rows of Day-Brite, two-lamp, 40-watt, RLM, daylight fluorescent units on 6-ft. centers. These 14 fixtures, mounted 8 ft. above the floor, with the machines centered between the rows, blanketed every portion of the machine with 60 foot-candles of shadowless, comfortable illumination (measured after 11 months of operation).

Employee reaction was heartening. Plant superintendent Walter Teut was so impressed with the results of this newly relighted area, and depressed by the contrast of the old lighting in the rest of the plant, that the idea of a complete plant relighting project took form. Continuous row fluorescent

Relighting

60 foot-candle fluorescent job.

lighting was the answer he was seeking. He wrapped up the recommendations and estimates of Aik and Gogan, took them to his progressive and understanding management—and got the green light.

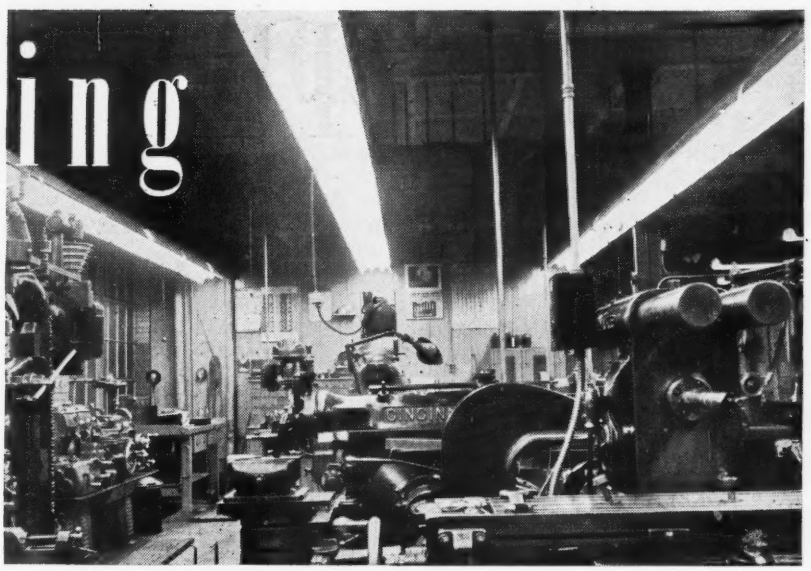
The drill press department was next in line for a face lifting. Continuous rows of six fluorescent units, each with two 40-watt, daylight lamps, were mounted nine feet above the floor and along the edge of each bench—the units being aligned with the center of the drill press spindles. Row spacing naturally varied with bench spacing. A third row of units illuminates miscellaneous machines behind the drill press benches. Average illumination intensity is from 35 to 40 foot-candles.

Lighting in the model shop, where the first piece of equipment is carefully made before going into mass production, was revamped with three, 8-unit continuous rows of fluorescent fixtures on 8½ ft. centers. Mounted nine feet above the floor, the two-lamp, 40-watt, daylight units provide a very uniform 45 foot-candle intensity on the working plane.

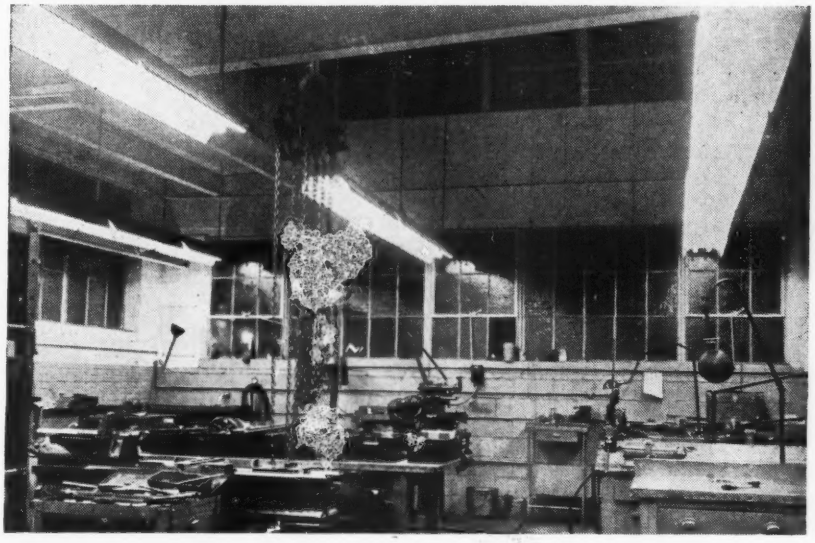
The largest plant area, the turret lathe department, was completely revamped with six continuous rows of fluorescent units totaling 104 fixtures. Rows are on 8-foot centers with the two-lamp, 40-watt, daylight units chain suspended nine feet from the floor. Three pull switches control each row of fixtures. You can walk in any part of this area and the light meter needle will vary only slightly from the 60 foot-candle mark (maintained intensity). Machine operators are highly pleased with the quality and even distribution of this new lighting.

The highest lighting intensity, of course, is at the inspection tables. Here fluorescent units, salvaged from previous test installations, are mounted 24 inches above the table on messenger cable and conduit suspensions. With

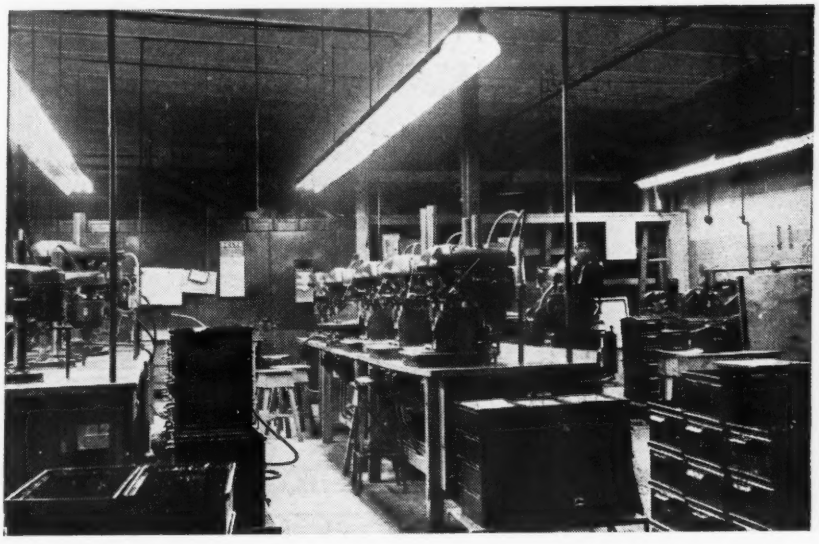
[Continued on page 114]



***MODEL SHOP**, where first models of products take form, is relighted with three continuous rows of fluorescent fixtures.*



***TOOLS** are made under 75 to 80 foot-candles (after 100 hours) of daylight fluorescent light in this tool department.*



***DRILL POINTS** are evenly illuminated by rows of fluorescent units aligned with center of drill press spindles.*

Equipping Your Small M

A guide to what equipment and shop layout is necessary, to economically operate a small motor shop business presented by an authority who has made small motor repairing a profitable enterprise.

YOU are fully aware of the present critical shortage of small motors and the dire need of repairing as many of them as possible. You, too, are aware of the apparent fact that our industry seems to be cycling toward a small motor trend—that in the not too distant future, if not already, the majority of units coming into your shop will be smaller motors.

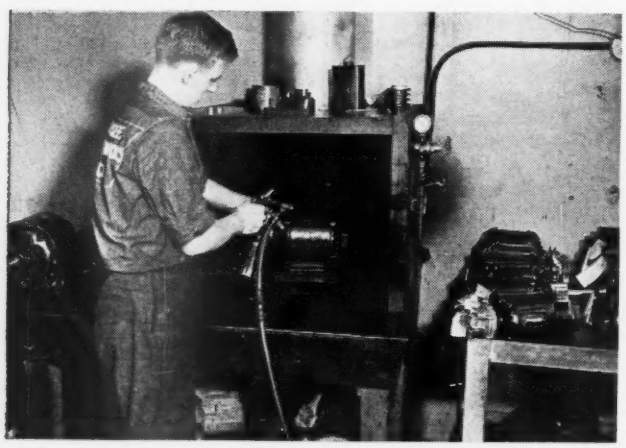
What are you doing about this? If you haven't already set yourselves up to properly handle these units, it's probably because you have heard repeatedly that there is no money in small motor repairs. The real question isn't "Can you make money in your small motor departments?", but—"Are you *willing* to make money in your small motor department?"

Many shops have definitely shown that profits can be made in the repair of small motors—if they are handled in the right way. Shops now operating small motor departments will agree that it requires not one but all of the following requirements:

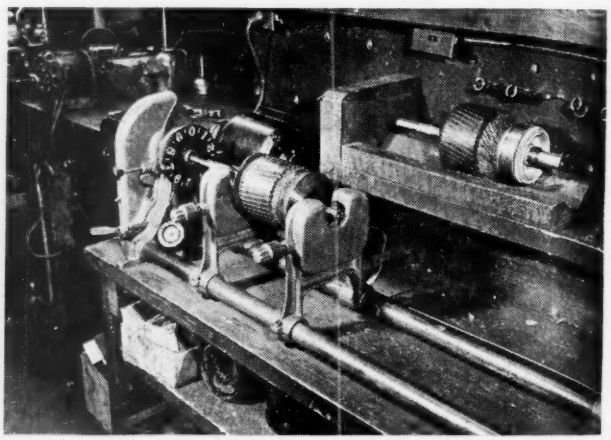
1. Proper equipment.
2. Ideal shop layout.
3. Good operating methods.
4. Trained personnel.
5. *Your* attention.

This article will be limited to a discussion of shop equipment and layout. The subject of operating methods and training personnel will be reviewed in an article by M. G. Miller, of our Knoxville branch, which will appear in a subsequent issue of *Electrical Contracting*.

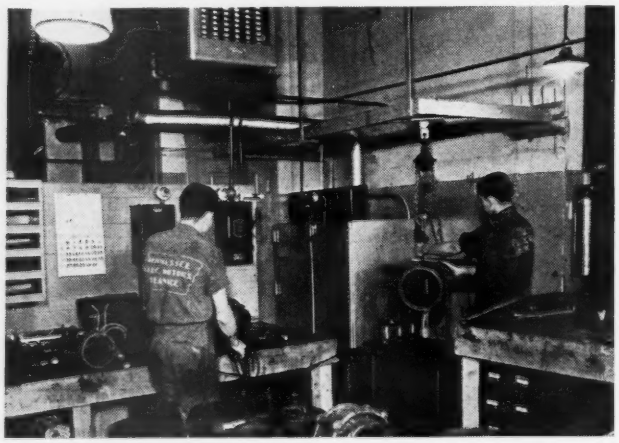
As to equipment needed, the accompanying lists are divided into two categories—the essential or "must" items and the additional or "improvement"



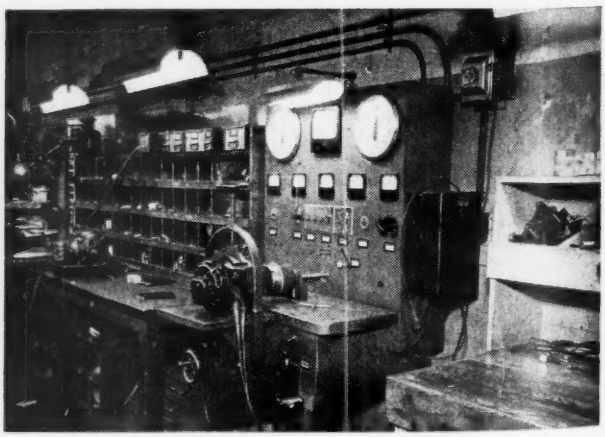
***FINISHING TOUCHES** are put on motors in this compact paint spray booth adjacent to shipping bench. Exhaust fan removes fumes and keeps shop area clean.*



***DYNAMIC BALANCER** saves hours of time in perfectly balancing the motor armatures. Board "wall" behind unit has holes to accommodate spare armatures.*



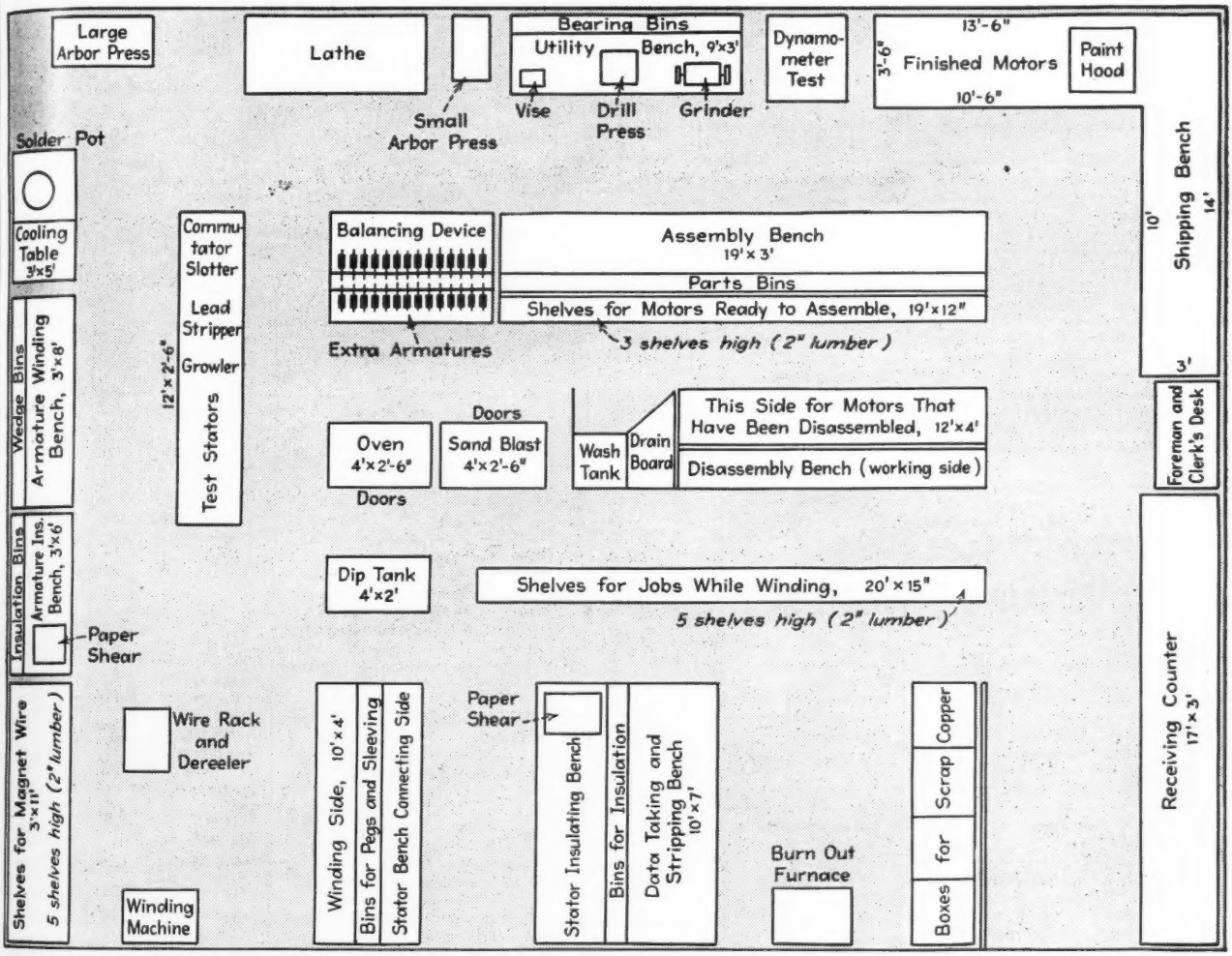
***COMPACT ARRANGEMENT** of bake oven with adjacent dip tank and monorail chain hoist speeds up the flow of repair jobs through the shop.*



***DYNAMOMETER TEST SET** puts all motors through their paces before they leave the shop. By giving motors "the works" before shipping, call-backs are reduced.*

Motor Department

By
H. E. Grant*
Tennessee Electric Motor Service
Nashville, Tennessee



***IDEAL SHOP LAYOUT** for small motor repairs has an orderly arrangement of benches and equipment to expedite the free flow of work through the shop. Wasted steps are reduced to a minimum. Dimensions and functions of various work benches and equipment are indicated for each work station.*

items which are listed in the order in which they should be added. If you want to "shoot the works" in the beginning, buy all the equipment in both lists. But, if you want to sort of "feel it out" then first buy the essential equipment—which should be had before you even open your doors—and then go as far down the list of "improvement" items as you care to go. Equipment items considered special are listed with ordering specifications, our source of supply and approximate cost. For such standard items as lathes, bake ovens, etc., there are numerous supply sources so this information is not added. And you will probably make such items as dip tanks, benches and other simple equipment.

One important adjunct to efficient shop operation is plenty of bench and bin space to permit a free flow of the work through the various repair processes. Work benches in our shop have been standardized with a uniform height of 33 inches and are covered with a hardwood facing. Our "must" benches include the following:

1. Receiving Bench—with two, 2-in. thick shelves underneath for storing stock and finished motors.

2. Disassembly Bench — with one heavy shelf underneath for storing motors awaiting special parts; also a 2-in. by 4-in. buck-rail down the center of the bench top and in 17-inches from one side. Motors to be disassembled will be on one side and metal pans to hold motor parts on the other.

A disassembly test set, with 110-volt supply, (No. 16 on essential list) for preliminary testing to determine extent of repairs should be mounted slightly higher than eye level and preferably on a trolley.

3. Assembly Bench—with complete set of bins and receptacles within easy reach of assemblers. One method is to mount tops of glass fruit jars on offset tiers of 2 by 4's about three feet above bench. Jars holding spare parts, screws, washers, etc., can be quickly screwed or unscrewed in the tops.

Bench should also have an ammeter and switch (preferably foot type) with insulated test leads for making preliminary tests on assembled motors

**From a paper presented at the NISA War Conference in Cincinnati April, 1944*

ESSENTIAL OR "MUST" EQUIPMENT

Item No.	Description of Equipment	Source	Approx. Cost—each
1.	Engine Lathe—11"–14" swing, 3-1/2'–4' bed, with universal self-centering chuck and accessories		
2.	Dynamometer Test Device	Potter & Rayfield Inc., Atlanta, Ga.	$875.00
3.	Drill Press—15-in.—size 0-1/2-in. capacity with complete set of drills and taps.	Atlas Press Co., Kalamazoo, Mich.	$75.00
4.	Small Arbor Press—Atlas No. 2B-1	Atlas Press Co.	$100.00
5.	Set of Special Press Plates with master plate for dismantling special parts of motors.	Potter & Rayfield, Inc.	$90.00
6.	Set of Special Press Attachments including: 1 No. 630 Sheave attachment 1 No. 952 A bearing attach. 1 No. 951 bearing attach. 1 No. 950 bearing attach.	Owatonna Tool Co., Owatonna, Minn.	$50.00
7.	Reamers 1 set expansion type align, 1/2" to 1-1/16" 1 set expansion type plain, 1/4" to 1-11/32"	L. O. Beard, Tool Co., Lancaster, Pa.	$125.00
	One each, plain non-expansion 1/2", 5/8", 21/32", 11/16", 3/4"	Complete-Reading Electric Co., Chicago, Illinois	$18.00
8.	Balancing Ways—10" swing	Ideal Commutator Dresser Co., Sycamore, Illinois	$32.00
9.	Tail-Stock Attachment for turning centerless armatures No. 445 Jacobs Bronze Jaw Chuck—1/4" to 3/4"	Atlas Press Co.	$8.00
	No. 1 Line Center with FL and F center pieces	Ideal Commutator Dresser Co.	$21.00
10.	Special Commutator Boring Tool No. PG-2139F, Det. 4, Grade 44A	Carboloy Company Detroit, Michigan	$28.80
11.	General Lathe Tool Assortment—carbide tool bits, boring tools, cutting off tools, 1" and 2" micrometer calipers, etc.		
12.	Air Compressor—at least 1 HP		
13.	Paint Spray Gun and hood with turntable and exhaust fan		
14.	Metal Parts Pans—11" x 15" x 3". Ordinary bread pans will do. Quantity depends on volume.		
15.	Bench vises—two, medium size		
16.	Test Set for disassembly bench—0–25 scale ammeter in series with two leads with spring clips and insulators. With 30 Amp. snap switch.	Mueller Electric Co. Cleveland, Ohio	
	Hi-Voltage Ground Tester and continuity test light. (can be made)		
17.	Wash tank—equipped with fluid and compressed air spray gun, filter, drain board and exhaust fan. Can be made or purchased	Practical Products Co., St. Paul, Minn.	$75.00
18.	Coil Winding Machine—Type F	Potter & Rayfield, Inc.	$200.00
	No. 210	Ideal Commutator Dresser Co.	$295.00

Item No.	Description of Equipment	Source	Approx. Cost—each
19.	Single-phase Concentric Head Type S. P.	Potter & Rayfield, Inc.	$40.00
	Set-Up Calculator for above head	Tennessee Electric Motor Service Nashville, Tenn.	$22.50
	No. 20	Ideal Commutator Dresser Co.	$74.00
20.	Three-phase Group Winding Head Type J No. 117	Potter & Rayfield, Inc.	$190.00
	No. 5	Ideal Commutator Dresser Co.	$35.00
21.	Insulation Shears 1–24" (Stator Winding)	John Jacques Co., Worcester, Mass.	$88.00
	1–16" (Armature Winding)	John Jacques Co.	$53.00
22.	Insulation Former or Folder No. 10	Ideal Commutator Dresser Co.	$37.50
	10" Folder	Potter & Rayfield, Inc.	$35.00
23.	Stator Coil Puller (can be made)		
24.	Burn Out Furnace—small fire-brick furnace 18" x 18" x 24" inside measurements (built on premises)		
25.	Hi-Voltage Insulation Tester (Stator Winding Dept.)	Ideal Commutator Dresser Co.	$38.00
26.	Thermo-Grip Soldering Device No. 2 Midget	Ideal Commutator Dresser Co.	$18.50
27.	Soldering Pot and Furnace No. 20	Johnson Gas Appliance Co., Cedar Rapids, Iowa	$25.00
28.	Armature Winding Racks—Two-"Standard" adjustable for 1/10 to 5 hp. armatures	Tennessee Electric Motor Service Knoxville, Tenn.	$20.00
29.	Armature Banding Outfit—adjustable rack with crank and tension device for 1/10 to 5 hp. armatures	Tennessee Electric Motor Service, Knoxville, Tenn.	$40.00
30.	Growler—preferably an adjustable type		
31.	Assembly Bench Test Set—at least one 0–25 scale ammeter		
32.	Bench Grinder—equipped with one ordinary and one silicon carbide wheel		
33.	Buffer—wire brush type—3/4 hp.		
34.	One Yankee Automatic Return screw driver for disassembler		
35.	One Little Giant Puller—for pulleys, gears, etc.	Complete-Reading Electric Co., Chicago Illinois	$5.00
36.	One Delco Collar Puller	Frigidaire Corp.	$3.50
37.	Thread Chasing Files—one set No. 1 and No. 2	Reiff & Neston Co., Tykens, Pa.	$3.50
38.	Two small electric soldering irons for assembly bench		
39.	One pair E-Z No. 1 wire stripper for each assembler and stator connector	Ideal Commutator Dresser Co.	$4.00
40.	Plenty of ordinary small hand tools for each worker		

before they go to a dynamometer for final test.

A Polishing Head (listed as No. 2 under additional equipment) is mounted at the end of this bench where capacitor and split-phase motors are assembled.

4. Utility Bench—with vise, drill press, grinder, and bearing pins above and reamer and commutator bins and racks underneath—handy to adjacent arbor press (see shop layout).

5. Finished Motors and Paint Bench —equipped with a 3/16-inch metal top and a 30-in. by 30-in. by 24-in. paint spray booth with turntable and exhaust fan.

6. Balancing and Extra Armature Bench—of proper height to accommodate static or dynamic balancing device at easy working level and equipped with a center double "wall" of 2-in. thick wood, about 4-ft. high, with holes drilled on both sides to accommodate spare armatures. Shelves underneath hold extra stators.

7. Winding Job Shelves—built of 2-in. material about five shelves high with lower shelf 15-inches high and others 11-inches high.

8. Data Taking, Stripping and Stator Insulating Bench—with bins on top for ready-cut insulation and high enough above bench top to permit sliding stripped stator to insulating side of bench. Shelves under bench hold sheet insulating paper.

9. Stator Winding and Connecting Bench—with bins and shelves for pegs and sleeving facing winding side and high enough above bench top to permit passing wound stator to other side for connecting. Bins and shelves under bench hold data cards, slot wedges, tool boxes, etc. Connecting equipment such as Hi-Voltage Tester, Thermo-Grip soldering device, etc., are mounted to back of top bins as are pipe supports for spools of lead wire, cotton sleeving, tape, etc.

10. Armature Insulating Bench—with top bins for ready-cut insulation and pegs and shelves underneath for sheet insulation and fibre.

11. Armature Winding Bench with top bins for slot wedges and, if armatures are wound by hand, a mounting for magnet wire reels. Space underneath holds insulated armatures ready to be wound.

12. Solder Pot Bench and Cooling Table—with solder pot bench only 16-in. high to bring top of pot level with 33-in. high cooling table which is covered with ¼-in. sheet iron. Holes drilled in table top accommodate soldered armatures — commutator-shaft down. Metal helps cool commutators quickly and takes out buckle that sometimes occurs. Shelf under cooling table holds extra solder, flux, etc.

13. Armature Test Bench —with shelves underneath for armatures and wire. Mount test equipment including growler and, if sufficient volume of Delco motors come in, mount permanently to the bench one of each of the four different bores of Delco stators—each equipped with a switch which breaks the circuit through a 0–25 scale ammeter. This provides quick means of testing Delco armatures for shorts after being wound and before soldering. Bench will also accommodate commutator slotter and undercutter and lead stripper (Nos. 1 and 4 on improvement list).

Shop Layout

One prerequisite of efficient shop operation, whether it be for small or large motor repairs, is an orderly arrangement of equipment. This is vitally important to the small motor repair shop since economical operation depends upon a large volume of motors going through the shop each day. Steps saved means dollars saved. Improper arrangement handicaps the advantages gained by having the proper equipment. Both must mesh together to make a smoothly operating production line.

In the illustrated ideal shop layout the various benches, machines, tools and parts stock are arranged so they are handy to the workers thus minimizing wasted steps. If you do not start with all of the equipment listed, make certain that you leave space for it so it will fit into the production line when you do acquire it.

Your building or space available may not permit you to duplicate the attendant layout, but by a little shifting of equipment the general idea can be adapted to provide efficient operation for almost any size shop. A shop of the size shown and with the equipment indicated is capable of handling a volume of about 50 to 60 motors per day with about 300 motors in process at all times without over-crowding. It could be increased or diminished depending upon your anticipated volume.

Investment and Volume

Investment is a subject that must be looked squarely in the face. If you started with only the essential equipment listed, including all work benches and set-up expense for a shop layout such as the one suggested, your invest-

[Continued on page 167]

"IMPROVEMENT" EQUIPMENT LIST

Item No.	Description of Equipment	Source	Approx. Cost—each
1.	Commutator Slotter and Undercutter No. 10 Hullhorst (with high centers) complete with: Set of saws for No. 12-18 wire, O. D. 1-1/8" with arbor Set of saws for No. 16-22 wire, O. D. 7/8" with arbor Set of mica saws for .010-.030 mica, O. D. 3/8" with arbor	Hullhorst Mica Tool Co., Toledo, Ohio	$165.00
2.	Armature and Rotor Polishing Outfit—made with 6" or 8" self-centering chuck mounted on shaft and pillow blocks and driven by a 1/3 or 1/2 hp., 1200 rpm. motor. Mount on end of assembly bench.		$90.00
3.	Large Arbor Press—Atlas No. 28	Atlas Press Co., Kalamazoo, Michigan	$275.00
4.	Amature Lead Stripper—Type BLS	Potter & Rayfield, Inc., Atlanta, Georgia	$113.50
5.	Pneumatic Air Chisel—Size CP-V2 (Stripping Dept.) Set of 3 special chisels (can be made)	Chicago Pneumatic Tool Co., Chicago, Illinois	$55.00
6.	Dynamic Armature Balancer—Model 340R	Bear Mfg. Co., Rock Island, Illinois	$400.00
	Wagner Dynamic Balancer	Arthur Wagner Co., Chicago, Ill.	
7.	Flexible Shaft Grinder		
8.	Welding Outfit—electric and acetylene		
9.	Sand blast Cabinet	Mott Sand Blast Mfg. Co., Chicago, Illinois	$275.00
10.	Portable Undercutter—for vertical face and large armatures		
11.	Power-Driven reamer drive		

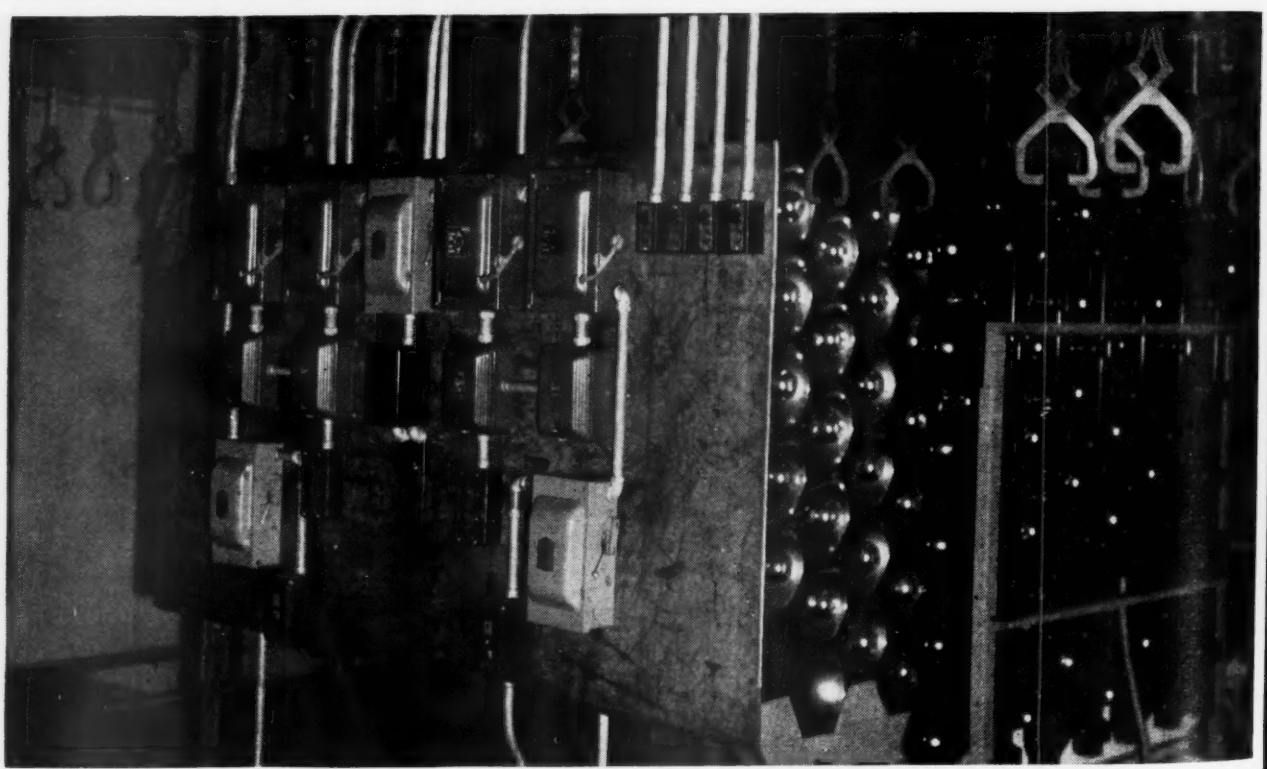
Infra-Red PAINT DRYING

Chain conveyor carries oxygen bottles through two infra-red ovens to dry the two coats of paint applied to meet service specifications.

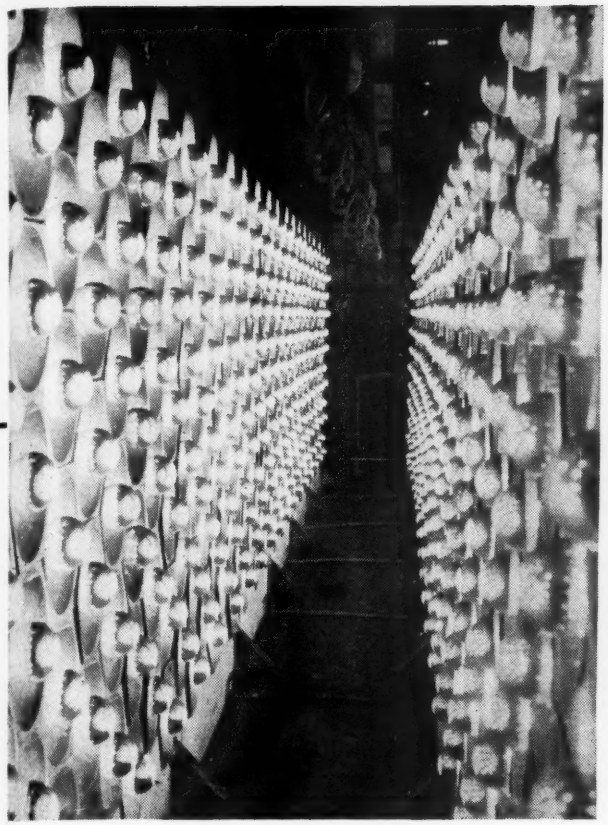
TO speed production of oxygen bottles, Harrisburg Steel Corporation has installed a conveyorized paint spray and drying system. Two infra-red ovens were designed to speed this finishing process; a small one to dry the primer coat and a second, larger oven to dry the second coat which is the Army's olive-green.

The chain conveyor rides on an overhead mono-rail. The chain, which supplies only the driving force, is suspended from a set of evenly spaced trolley wheels as shown in the accompanying pictures. From each set of trolley wheels is hung a swivel joint and an ice-tong clamp. The bottles are loaded onto a platform of correct height so that the operator has merely to place the open jaws of the clamp around the bottle neck and hold it there till the conveyor pulls the bottle off. The bottle's own weight then supplies the force necessary to hold it.

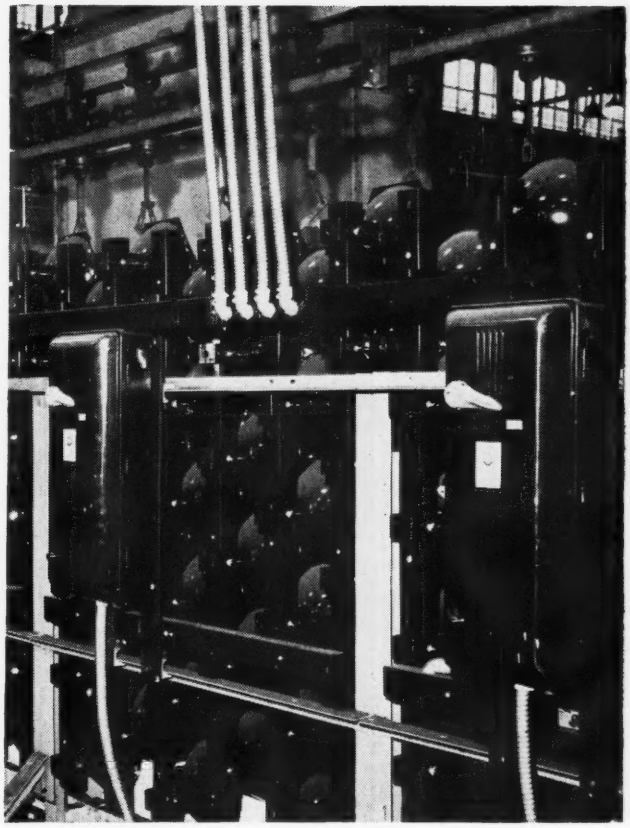
The swivel permits turning the bottle, both during painting and drying. Automatic rotation of the bottles is obtained through the use of steel pins which extend at an angle so that as the bottle passes by, the pin strikes the arm of the tong clamp and partially rotates the bottle. Successive pins rotate it through 360 degrees so that the painter can spray the bottles quickly and easily without touching them, and the paint may thoroughly dry on all



***MAIN CONTROL PANEL** for the painting and drying system. Safety switches and magnetic breakers control paint booth motors. The four pushbuttons at upper right hand corner of panel control the lamps.*



THE LARGE OVEN is composed of fourteen banks with 36 lamps per bank. Reflectors are gold leaf to provide a maximum reflection efficiency.



MAGNETIC CIRCUIT BREAKERS are mounted on back of portable bank framework. Power is supplied 440 volt, three phase, three wire to lamps in series.

sides while passing through the ovens.

The bottles first enter the primer booth where they are sprayed with a priming coat. The conveyor then makes a hairpin turn through the small bank of lamps where the primer coat is quickly dried. They are then carried through a second spray booth where they get a coat of olive-green, and then on to the larger oven for final drying.

Infra-red Ovens

Both ovens are composed of portable banks and each bank is provided with 36 infra-red lamps rated 250 watts 120 volts. Power is supplied at 440 volts, 3 phase, 3 wire, so that four lamps are connected in series across each phase.

There are a total of 16 portable banks with 36 lamps per bank, making a total number of lamps in both ovens of 576. The small oven uses 72 lamps, or two portable banks while the large oven uses 504 lamps, or 14 portable banks.

The reflectors are clamped to the square raceway wire ducts in such a manner that the reflectors are adjustable. That is, they can be moved in or out to control the amount of reflected heat striking the bottles. Reflecting surfaces are gold-leaf to obtain maximum reflection efficiency. The assembly is then mounted on an angle-iron frame equipped with caster-wheels to permit easy movement in correctly positioning the banks for most efficient operation.

System Control

The 576 lamps are controlled through four magnetic circuit breakers by pushbutton stations mounted on the main control panel for the entire painting and drying system. The magnetic switches are mounted on the back of the oven frames as seen in the accompanying photograph. Each breaker controls 144 lamps with 48 lamps connected across each phase. At 250 watts per lamp, each breaker carries 36 kw., or one-quarter of the total 144 kw. The leg current of each magnetic switch is about 47.3 amps per phase.

The main system control panel consists of a section of plywood on which are mounted all the pushbuttons, safety switches, and magnetic and manual breakers. The conveyor motor, the paint-booth motors and fans, and the infra-red lamps are all controlled from this point.

Infra-red heating and drying is most successful in surface work where depth of heat penetration is not too great. It has been found very efficient in drying freshly painted surfaces (such as used here); in drying electrical coils after varnish dipping; in drying rubber cement and sprayed rubber layers in the fabrication of rubber goods; in drying textiles at various stages of manufacture; and in the dehydration of foods. It also has been the answer to drying tax stamps on tobacco cartons without altering the moisture content of the tobacco within, because of its surface drying characteristics under conditions of intense exposure of a short duration. These are only a few applications of infra-red drying to production processes. Infra-red portable banks have also proven extremely valuable in maintenance. Water soaked insulation has been successfully dried at the equipment's location, making it unnecessary to dismantle, transport to stationary ovens, return to location and reassemble. In this way many valuable man-hours of production time have been saved by portable infra-red ovens that can be easily moved to the location of flooded switchboards, transformers, motors or control, for quick drying.

EDITORIALS

W. T. Stuart, *Editor*

Shutdown Maintenance Needs Skilled Service

It is obvious to most men who are in charge of buildings where machinery and electrical apparatus are used that expert skills are required for installation and proper maintenance. And working equipment usually receives good care.

But when apparatus is shut down for a period, such as heating plant equipment during the summer months or elevators in a temporarily vacant building, skilled shutdown care is the exception rather than the rule. The motor circuit disconnect switch is opened, distribution panel fuses are removed and that is all. Dirt, dampness and corrosion go to work on the idle equipment which rapidly degenerates from idle to useless.

Shutdown preparation of electrical apparatus is an expert job and ought to have the same critical attention of skilled mechanics as the initial installation. Exposed metal must be greased, controllers must be sealed to dirt and dust, windings must be thoroughly protected from dampness. It is usually advisable to remove the motor for storage in a dry location.

One large electrical maintenance outfit in New York offers a special service on elevator equipment when it must be out of service over a long period. It is a type of service that most motor shops could handle effectively and to the great benefit of the customer. And it is a type of work that will need special emphasis during the reconversion period.

Cleared Draft Picture Helps

Selective Service regulations have finally drawn a comprehensive picture of military manpower needs through the rest of the year. Much of the uncertainty which business men have had to contend with in recent months has been cleared away, an improvement in manpower planning that ought to show a direct benefit in production and efficiency.

Virtually all of the 18 to 26 year old men will be called up. Of the 26 to 30 year old men, those in essential jobs in essential industries will rate deferment. In the 30 to 38 range occupational deferments to those in essential industries will be the rule.

However, it is important that employees file requests for deferment on 42-A or 42-B form so that draft boards will have specific information in their records upon which to classify the men over 25.

As in all war regulations, the future prospects depend upon the military needs. They can change over night. But the current regulations is already helping employers to meet a seriously critical manpower problem.

New Code In 1945

Committee work on the next revision of the National Electrical Code is underway. It will be published in 1945 and the schedule of preliminary deadliness for recommended change has been set. Suggested revisions from outside the committees must be in by September 30 of this year. Committee reports must be ready December 15 and the Electrical Committee will meet in May 1945.

Code revisions are always important. The 1945 Code committees carry an unusual responsibility, however. They are writing the Code of reconversion and they are making rules under which the postwar electrical industry must live and prosper and grow.

War conditions have been destructive to Code standards. However, they have strengthened the bonds of the electrical industry, ancient rivalries have disappeared in the need for common effort. It will not be easy to write rules adaptable to peacetime conditions while war is still our first job. But it is safe to predict that this Code will be the product of more genuine cooperative effort than any in history.

War Will Change Building Methods

While we are apt to think of our country as highly developed in mechanical methods before the war, the plain fact is that millions of young men in military service are seeing and handling mechanical equipment and power operated tools for the first time. The high order of development of automatic machine tools in the automotive industry, the roaring continuous strip mills of the steel industry and the elaborate structures of oil refining have been cited frequently to show the mechanical development of industry in general. Actually, outside of the mass production industries, the level of mechanization before the war was limited to a relatively few industries. Hand work still carried a large burden of production and this was especially true in building construction.

Men returning from the war who have seen bulldozers clear jungle airfields, who have supervised mechanical loaders at a rail siding and who have handled all manner of machines to do hard jobs quickly are going to be impatient with old ways. And from war production a host of modern techniques will follow the dispersal of men to peacetime industries.

The electrical contractor will feel the effects in two ways, first, in a greater use of power operated tools in his own work and second, in more elaborate temporary wiring for other building trades.

Communication Centennial

The hundredth anniversary of the first telegraph message was celebrated last month. The make and break of a key operating a sounder clicked out a brief message. A great industry was born. It grew up to be called communication, a mature, prosperous and highly technical member of the electrical family.

From the simple ticks of Morse's

sounder to modern industrial signalling and communication is a long step. There is little left of the original method but the wire. However, the job is still the same, to carry thoughts and ideas and words from one mind to another over a distance at high speed.

While we are contemplating the wonders of modern telegraph and telephone, and the great marvels of communication in the electronic age, it might be well to note that a business man can often talk to a branch office across the continent quicker and more easily than he can reach some key man in his own shop.

Though they lack the drama of great distances and elaborate networks, local signalling and intercommunication systems are important links in business and industrial communications. And technical developments have been rapid in recent years. Talk-back paging and industrial music are examples that have contributed notably toward speeding war production.

It is a field that still needs creative salesmanship. Though its history goes back a hundred years there is plenty of room yet for new application ideas, and right in our own backyard.

Maintenance—A Necessary Lighting Cost

We are gradually assembling experience data, within the industry, on the maintenance of lighting systems. Some of this data has been published and widely read. More interest centers around the subject than ever before. And, along with more knowledge of lighting maintenance, we are getting better maintenance.

Much of the time-study and method data is concerned with fluorescent lighting and there has been some inclination to think of large scale lighting maintenance work as exclusively a fluorescent lighting system problem. It is not. It is a problem that inevitably follows wherever lighting becomes an active and efficient part of the manufacturing process, the office routine, or the sales atmosphere. And conversely, wherever lighting is only incidental to activity, maintenance is reduced to a minor problem of lamp replacement.

That lighting maintenance has become a problem and a considerable element of lighting expense indicates a new phase in the progress of an advancing technology. To the ordinary care required for maintaining the worth of the lighting system and fixtures we have added routines concerned with maintaining its light output or usefulness as near as practical to the original design values.

And as lighting goes forward, the latter concern will become more and more important. Good lighting inevitably requires good maintenance. While every effort should be made, in fixture and lamp design, in system layout and in installation to hold down maintenance costs, such economies should operate toward better and easier maintenance within the range of the design standards of illumination.

Staging the Sale

A Southern contractor-dealer who aims to sell all-electric kitchens as a part of postwar wiring prospects has a unique sales room layout. Partition sections, portable and easily set up, duplicate the exact dimensions and window and door arrangements of the customer's kitchen. Cabinets, sink, range, refrigerator and other elements of the kitchen plan are then set in place. The customer sees his kitchen before the house is built.

The special advantages and virtues of this particular technique are a good subject for experts in sales methods. What we want to point out here is that this company has a practical plan ready to go and that the sales method goes beyond conventional methods. They know what they want to do and how they are going to do it. And that, it seems to us, is the kernel of all sound postwar planning.

Wiring Handbook Revision

An announcement that an industry committee is now working on a revision of the Handbook of Interior Wiring Design is good news. Ed Brand, of Buffalo, is chairman again. All of the major national associations of the electrical industry are represented on the Committee. There is new emphasis on farm wiring and the agricultural engineers have been asked to lend counsel and support toward adequate rural wiring.

We can confidently predict that the excellent work of the original handbook will be strengthened and broadened in its revision.

Washington Notes

► Invasion and its probable military results still underlie all Washington procedure. Material supplies, changes in limitation orders, civilian goods, manpower, Selective Service are discussed with invasion successes as the common factor in every plan.

► The materials situation remains satisfactory. Steel will be tight for some months yet, due largely to the tremendous tonnage required for trucks, ships and a great increase in heavy guns.

► Manpower, now very critical may ease off soon but will continue as an urgent problem even after invasion. Programs essential to the Pacific war theater still need more men.

► Possibilities of new construction programs of any size for war manufacturing are slight, however, the lid will come off civilian construction as one of the earliest moves toward a peacetime economy.

► Fractional horsepower motors continue to be among the most critical components in production. Enormous numbers needed for all kinds of military planes and vehicles are the reason. Even a slight reduction in the aircraft program would change the picture. Badly needed replacements for civilian requirements are going into regular trade channels. But hopes for new refrigerators and washing machines are dimmed by the shortage.

► Fluorescent lighting prospects hang on ballasts. Radio and radar transformers are using up available manufacturing capacity, materials and manpower. More ballasts will depend on military requirements for transformers which is not likely to ease off before the end of the year.

► Construction figures for February 1944 are reported as follows: put in place during that month, $193 millions for war industrial facilities of which $156 millions was government financed and $37 millions privately financed. The totals include construction, machinery and equipment. Non-industrial construction reported for the same month totalled $134 millions of which $69 millions was military and $65 millions housing.

► Any increases in civilian requirements will be handled without preliminary promises from WPB. High officials say that they will be certain that manpower, materials and critical components are available without risking war production.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

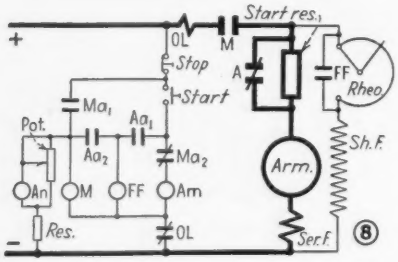
KNOWLEDGE OF CIRCUITS AIDS TROUBLE-SHOOTING CONTROL—NO. 3

By L. E. MARKLE *

CONTROL

Fig. 8 shows one method of connecting a full-field relay used with adjustable speed motors having a speed range in excess of two to one. Contactor FF operates on starting and remains closed until the last accelerating contactor drops out. In this manner the closed contacts FF short out the field rheostat thereby applying maximum field strength to the motor during the starting period.

Pressing the START button energizes coil A_m which opens contact A and closes Aa_1. Closing Aa_1 energizes coil FF and closes contact FF which shorts out the field rheostat. Aa_2 also closes energizing M and closes line contact M and holding-contact Ma_1. Contact Ma_2 opens de-energizing A_m and starts A_n timing. As soon as contact A closes shorting out the last of the starting resistance, auxiliary contact Aa_2 opens, de-energizes coil FF, opens contacts FF, and places the field rheostat in control of the shunt field strength.



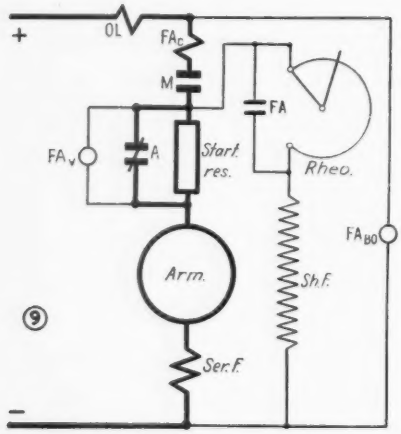
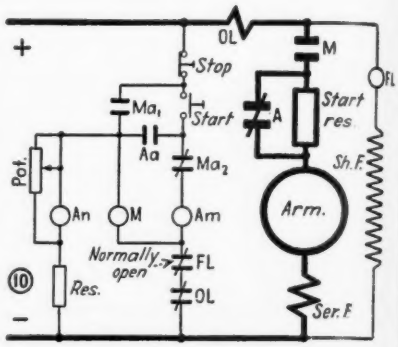
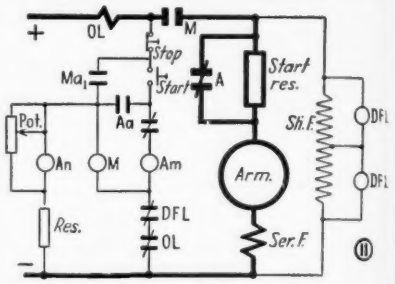


Fig. 9 shows another method of applying the full-field relay. This arrangement insures full field at starting, and provides for limiting the armature current when the motor is accelerating from the full-field speed to the speed set by the rheostat.

The field accelerating relay FA is equipped with two operating coils. One is a voltage coil FA_v connected across the starting resistance. The other is a current coil FA_c connected in series with the motor armature. The remainder of the control circuit is like that of Fig. 2. When the START button is pushed, opening accelerating contact A and closing line contact M, the voltage drop across the starting resistor (and likewise across coil FA_v) is practically line voltage and so relay FA is picked-up quickly, permitting a motor start with full field. After the proper time interval, accelerating contactor A closes and voltage coil FA_v is shorted out. However, closing contact A produces a current peak, strong enough to permit the current coil FA_c to hold relay FA closed. As the motor approaches full-field speed this current decays, allowing the FA contacts to open, weakening the motor field. As the motor attempts to accelerate, the line current again increases. If this increased current exceeds the pick-up value of FA_c, the relay will close its contacts, arresting acceleration and causing a decay of line current which again causes FA to drop out. High inductance of the motor field plus inertia of the motor and drive prevent rapid changes in speed. Hence the motor will not actually reduce its speed, but the increased field current will reduce the armature current and cause FA to drop out. The fluttering action will continue until the motor





reaches the speed set by the rheostat. Setting of the FA relay current coil determines the maximum current during this part of the acceleration period. Since relay FA must handle the highly inductive field currents, a good blow-out arrangement is necessary to extinguish the arcs. Hence the relay is usually equipped with a shunt blow-out coil, FA_{bo}.

Fig. 10 shows the incorporation of a field loss relay to prevent excessive speed should the shunt field become de-energized while voltage remains on the armature. The relay consists of a current coil in series with the shunt field and is adjusted to pick-up on full-field current, remaining closed at any current within the operating range of the motor field current.

The control circuit is identical to that of Fig. 2 except that contact FL has been introduced in series with the OL contacts. Operation however is the same. Contact FL is normally open (all circuits completely de-energized at the disconnect switch) however, closing the switch energizes the shunt field and the relay operating coil FL. Thus FL closes, setting-up the starting circuit for pressing the START button.

Control Engineer Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Presenting

THE COP

(Cut-Out-Premium)

STARTER

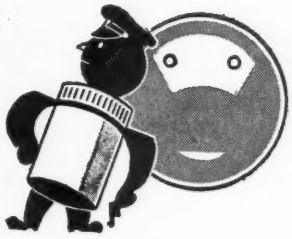
"One of Sylvania's Finest"

The COP (Cut-Out-Premium) Starter is ready to patrol your fluorescent installation to protect your lighting investment. The COP brings you the finest method yet designed by Sylvania engineers to cut a failed lamp out of the circuit.

The COP is equipped with a handy push button to reset the positive new circuit breaker. When you replace a failed lamp, you just push the button, and the COP continues to operate normally until another lamp fails.

The COP has shown a life expectancy five times that of the average starter in months of exhaustive tests under all possible operating conditions. That is why Sylvania particularly recommends the COP as a means of reducing the cost of maintaining fluorescent.

The COP stops annoying lamp blinking and flickering by cutting a failed lamp out of the circuit immediately.



The COP guards your electric meter, preventing waste of current.

The COP protects the ballast from overheating.

Post the COP, Sylvania's finest quality starter, on your own fluorescent "beats." For information, write to Sylvania Electric Products Inc., Boston Street, Salem, Massachusetts.

SYLVANIA FS GLOSTAT STARTER

WITH BETTER THAN EVER PERFORMANCE

A metal flag is spot-welded to the stationary contact post in the gas-actuated Sylvania FS Glostat Starter. This metal flag assures correct lamp cathode preheating. The new FS Glostat Starter is quicker-starting, can take rough handling, and preheats adequately for maximum lamp life. Recommended by Sylvania engineers for economy and efficiency in smaller fluorescent installations.

One Standard—the Highest Anywhere Known

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ELECTRIC PRODUCTS INC.

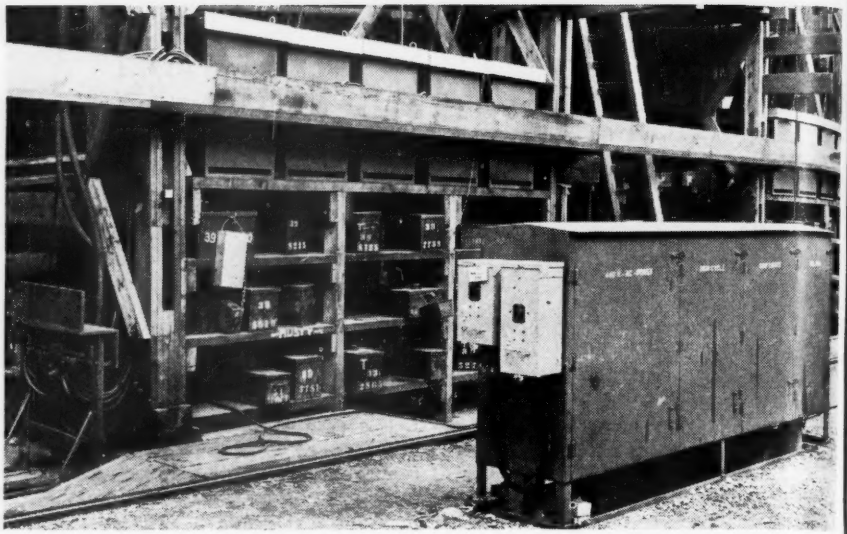
SALEM, MASSACHUSETTS

FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, INCANDESCENT LAMPS, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES

Thus, should the shunt field circuit become open, coil FL would be de-energized, and FL contact would open. This action would de-energize M and the main line contact would open to remove voltage from the armature.

This type of field loss protection however does not protect against the possibility of a short circuit across a part of the field, say across one field coil. This would cause an increase in shunt field current and a reduction in the motor speed. Thus it is seen that a series current relay would not respond.

Fig. 11 represents the case where differential field loss protection is provided. The differential field loss relay DFL is equipped with two voltage coils connected to buck each other. Each is connected across one-half of the field winding. Normally the voltage across each coil is the same, hence the relay armature stays in the out position with its normally closed contacts closed. Shorting out one field coil or other failure, causing an unbalance of these voltages, causes the relay to pick-up, opening its contacts and dropping out the line contactor, de-energizing the motor.



SHORE BOXES *such as this are located at various points on the piers of the dry slips in the Bethlehem-Hingham shipyard where navy DE boats are fabricated. Four separate services are supplied: welding, lighting, high-cycle and 440-volt, 60 cycle power. Substations feed the shore boxes via underground cable and services are taken from the boxes directly over shipside.*

MODERN ALL-ELECTRIC APARTMENT WIRING

RESIDENTIAL

The Miller-Liskey Electric Company of Hagerstown, Maryland completed recently an apartment house installation which included a neat looking false-front service panel and the wiring of individual, thermostatically controlled hot water circulators for space heating.

The all wood false-front panel accommodates the incoming service switch, the main connection pull-box and all the meters and trim switches. All wiring is run behind the panel front to make a neat appearing installation.

The underground service consists of two 3-wire lead-covered cables of 250 MCM size. Armored cable is used for all circuits running from the main pull box to the meters. The meter trim switches contain the range circuit fuses and the branch circuit fuses. Each apartment is provided with an electric range and refrigerator in addition to an individual heating system which is electrically controlled.

The apartment heating system is of the hot water type. Each individual apartment has its own thermostat which controls a motor driven pump located in the basement. The pump circulates hot water for heat as called for by the thermostat setting in the apartment. One branch circuit in each meter trim switch supplies current to its respective circulating pump motor.

The motors are all one-sixth horsepower, 1725 rpm. and the magnetic switches which operate them are mounted on a wood-board panel directly above the motors (as in the accompanying photo).

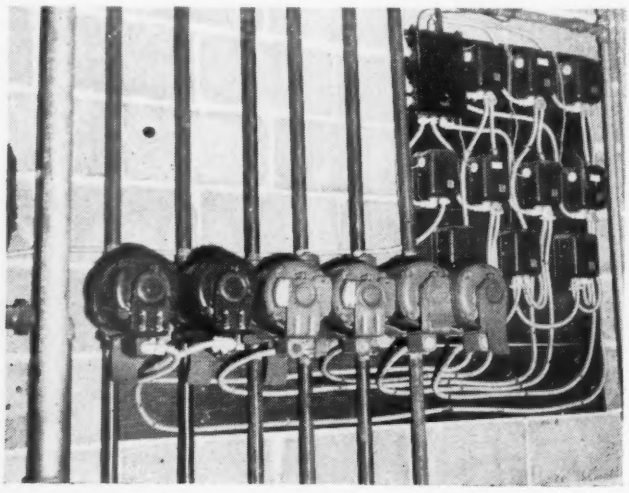
Thermostat leads and the branch circuits are all brought into the one pull-box on the heat control panel.

Fuel oil is used for heating the water in this otherwise all-electric apartment building.

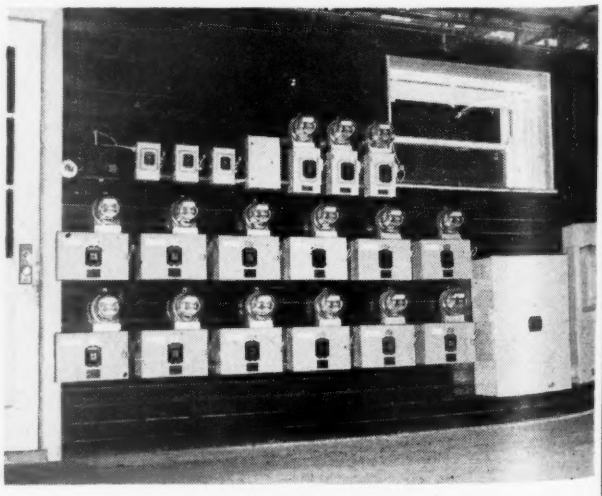
PUT A HANDLE ON IT

INDUSTRIAL

Pushbutton stations get plenty of pushing on the Farnham rolls in the



BANK OF SIX *hot water circulators that supply heat to individual apartments. Thermostats actuate magnetic switches.*

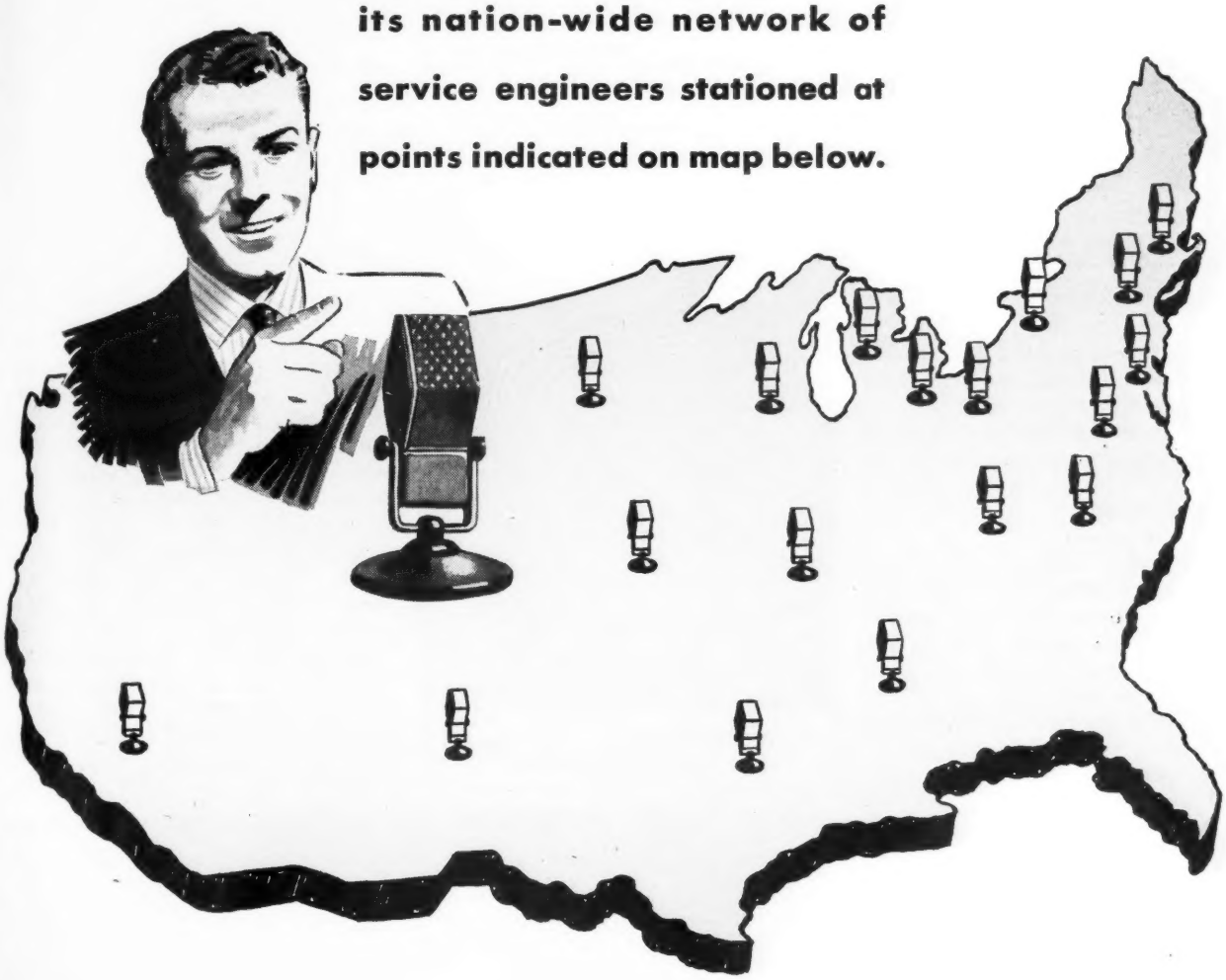


FALSE-FRONT *service panel for this new twelve-apartment building presents a very neat appearance.*

Quiz Show

COAST TO COAST

. . . sponsored by Monitor through its nation-wide network of service engineers stationed at points indicated on map below.



Answering questions and solving problems of automatic electric motor control is the job of Monitor Engineers—and, being specialists—you can always count on Monitor engineers to do their job well. Their knowledge covers all phases of electric motor control; plans, design, fabrication and installation. So, if you've got a motor control problem—get the sound, quick answer by calling in your Monitor engineer at once.

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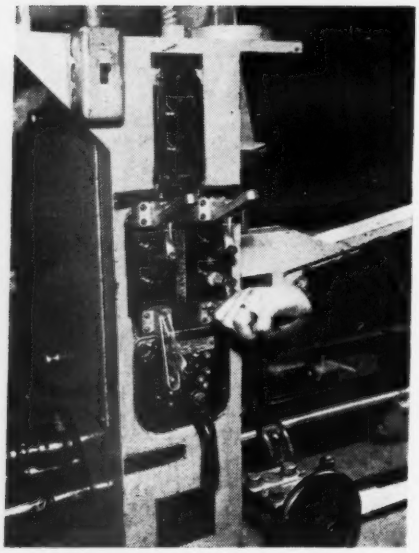


***PUSHBUTTONS** are equipped with handles to relieve the operator's fingers of the task of pushing the buttons an average of 4000 times per eight-hour day.*

plants of Fleetwings Division, Kaiser Cargo, Inc. During one eight-hour day an operator might easily push the buttons more than 4000 times, which makes it tough on the fingers. To improve on this operation, an employee suggested affixing handles to the control station buttons.

Consequently, Danley quick-acting clamps were adapted with a right-angle extension to do the pushing as pressure is applied to the handle. (see photo). The clamps are mounted on short lengths of flat steel which are in turn mounted on the face of the control panel.

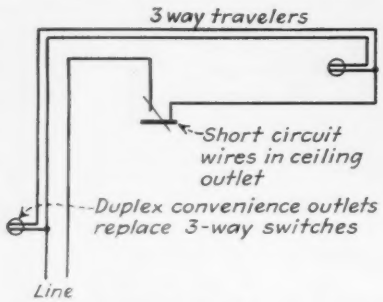
The operators were so enthusiastic about the handles that now all rolls at Fleetwings are so equipped.

UTILIZE INACTIVE SWITCH OUTLETS FOR RECEPTACLES

WIRING

Added convenience outlets which always please residential customers can be easily and quickly installed where ceiling fixtures are being eliminated during redecoration. By simply shorting the connections in the ceiling outlet before it is plastered over, a receptacle may be installed in the switch outlet box which is very often extremely useful.

This method is especially adaptable when three-way light control is used. Shorting the ceiling wires provides two receptacles as in the accompanying diagram. This kink has been used many times by Richard McGiffin electrical contractor, Canton, Ohio.

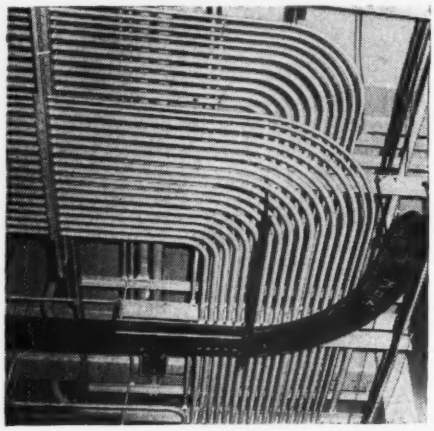


***CEILING OUTLET** wires are shorted and receptacles replace switches.*

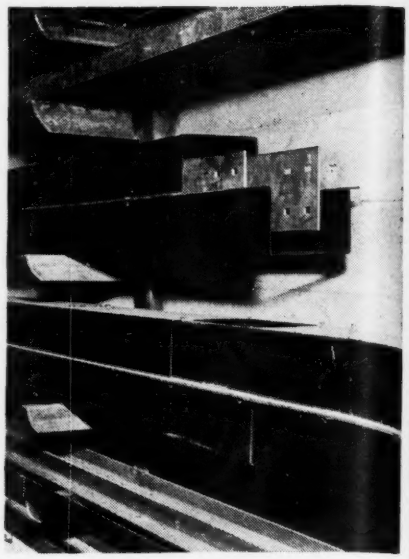
ANGLE IRON RACKS FABRICATED BY WELDING

INDUSTRIAL

Angle iron racks both for heavy cables and bus duct were fabricated by welding in the distribution tunnel between the power plant and other buildings at the Fontana steel plant of Kaiser Inc., in California. Bechtel-McCone-Parsons made the installation.



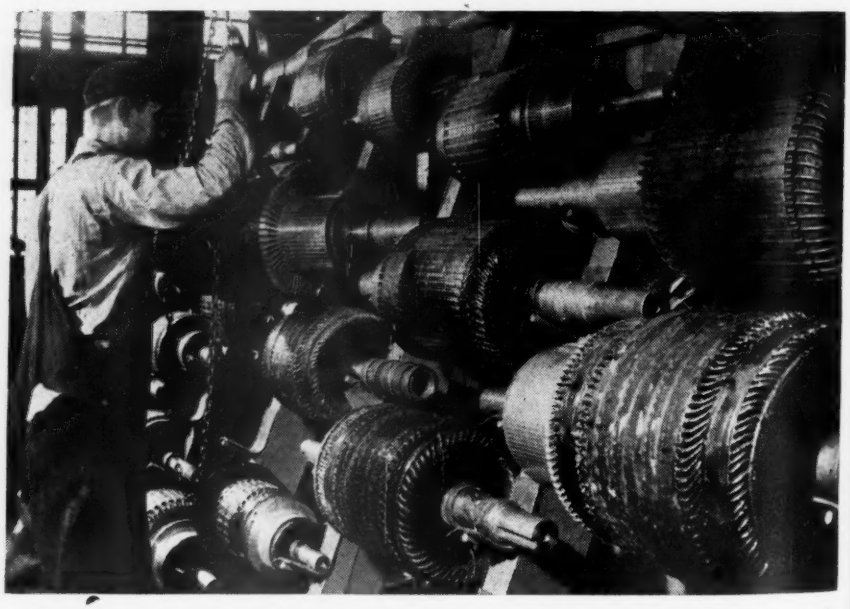
***CABLE AND BUS** duct racks made up by welding of angle iron.*



***CONTOUR FABRICATION** of channels of angle iron to bring cables from upper level to tunnel. Plywood floor was placed in the channels before the cables were laid in them.*

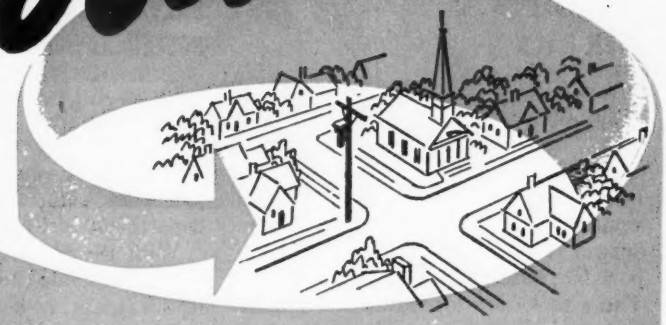
To vertical angle iron supports fastened to the concrete side walls, a series of horizontal brackets were welded. The bus duct was simply laid upon these brackets.

To carry the heavy cables between plants, channels of two angle irons were fabricated to lay in parallel on top of the brackets. A floor of plywood was placed in these channels and the cables laid in pairs in each channel. This method greatly speeded cable installation and makes them accessible for replacement or inspection.



***ARMATURE RACKS** used for orderly stocking of spares have great flexibility and capacity. Supports are made of wooden beams, drilled on varying centers to accommodate steel pins to carry the armatures. Pins are covered by short piece of old belting to protect bearing surfaces of shafts. Supports are spaced on varying dimensions to accommodate different size armatures.*

"On Location"



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Quick, low-cost reconversion . . . with Westinghouse CSP Distribution Transformers

Going "on location" to new postwar load centers is greatly simplified with Westinghouse CSP (Completely Self Protecting) Distribution Transformers. There is no time-consuming, costly disassembly and reassembly of nine or so pieces of conventional equipment.

Every part of the CSP transformer is built-in. To move it, all that needs to be done is: disconnect . . . take to new location . . . mount . . . reconnect. Tomorrow's unpredictable loads can be handled with minimum investment in time and money.

Many CSP transformers can be moved in the time ordinarily required for a few conventional installations.

Westinghouse CSP Distribution Transformers offer maximum *load adaptability* for better service continuity. A signal light warns of an overload before the internal breaker trips. *All* the thermal overload capacity is made *safely* available for short-time overloads.

For complete information, call your Westinghouse office or write for DD-46-100, Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa. J-70428

WESTINGHOUSE CSP DISTRIBUTION TRANSFORMERS CONTAIN:

- transformer
- "De-ion" arrester
- circuit breaker for overload and short circuit protection
- grounding gap
- current limiting resistor

WESTINGHOUSE

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

PACKAGED POWER

MOTOR SHOPS

PORTABLE OVEN RACK

When Excel Electric Service Company, Inc., prominent Chicago motor repair organization, recently installed a new, large, gas fired bake oven, they immediately devised a means of conveniently loading the oven. The answer was the construction of two portable racks to hold the equipment. These racks are loaded at the dipping tank, raised on shop lift trucks and rolled into the oven.

Each rack (there are two of them) is five feet high, four feet long, 29 inches wide, and constructed of 2-in. by 2-in. by $\frac{1}{4}$-in. angle iron. Horizontal angle iron shelf braces are welded to the uprights at 12-inch intervals. Removable T-iron, cross braces with chain slings rest on these shelf braces to suspend the dipped equipment. The two end cross braces near the top of the rack can easily be lowered to facilitate loading of heavy equipment.

Oven housekeeping is simplified by equipping each rack with sheet steel drip pans—two for each rack. They rest on the steel "floor" grating which is some seven inches above the floor to give ample clearance for the lift trucks. The two racks alternate between oven and dip-tank to provide continuous operation.

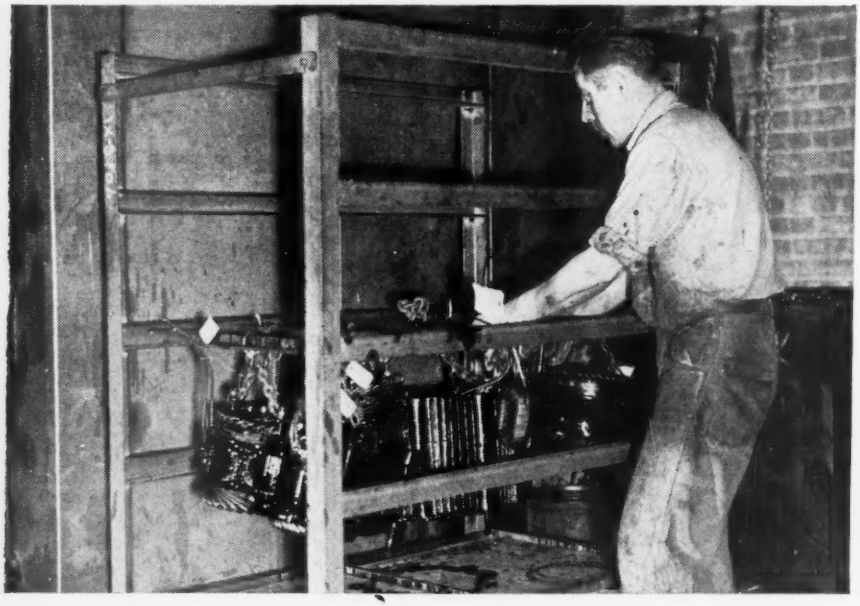
SALVAGE BROKEN POWER SAW BLADES

Power hack saw blades have a habit of snapping just as the hand type do. When this happens at the Loyd Electric Company, San Antonio, Texas, the pieces are returned to the motor shop department instead of the scrap pile.

With the front ground down and a wooden handle added, these broken blades make a handy shop tool for driving out slot wedges on motor repair jobs. Once the teeth of the blade dig into the slot wedge, it is an easy matter to push them out by hand. If the wedges stubbornly resist, a little gentle persuasion on the blade handle with a small mallet will do the trick.

BENCH TURNTABLE SPEEDS WORK

Give a man the proper tools and equipment and, no matter what type of job he is doing, his efficiency will climb. Remove the drudgery chores and productive manhours increase. These are two of the principles on which Scherer Electric Company of Indianapolis, Ind., bases its success as a motor service organization.



***READY FOR A BAKE**—This portable oven rack is being loaded with freshly dipped motor stators and other equipment prior to being rolled into the adjacent bake oven. A second rack will take its place ready to be loaded with another batch.*

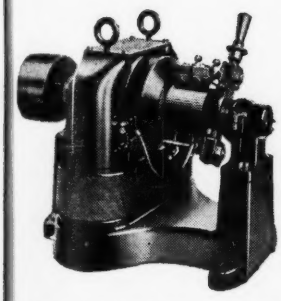
***WORK REVOLVES** on this bench turntable at Scherer Electric Company motor service shop. Wrestling to get heavy bulky equipment into convenient working position is no longer necessary.*

An extensive monorail system that reaches every workbench and piece of equipment in the well organized and planned shop was not enough for Scherer. Wrestling with heavy and bulky equipment at the workbench was another phase of inefficiency that could not be condoned. Hence we find every bench in the shop equipped with a convenient turntable that can be quickly dismantled and stored under the bench when not in use.

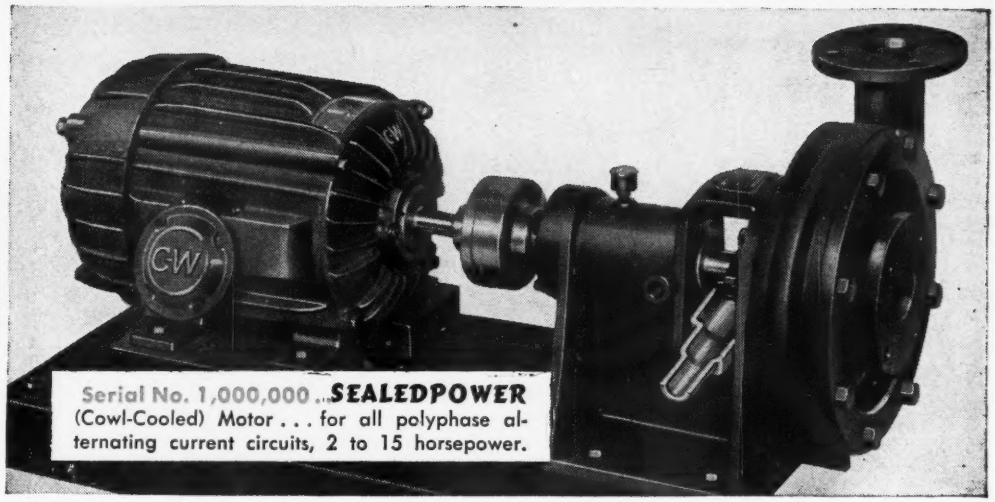
The table top is a 22-inch disk of $\frac{3}{4}$-inch plywood surfaced with a removable circular slab of $\frac{1}{4}$-inch hard Masonite which can be replaced when worn out. A solid steel rod, floor-flange mounted to the underside of the table, forms a pedestal which is supported by an 18-inch length of pipe sleeve welded to a movable channel-iron arm. Welded to the bottom of the sleeve is a large flanged nut through which passes a threaded bolt providing a 4-inch vertical adjustment.

Friction is reduced by placing a $\frac{3}{4}$-inch steel ball between the supporting rod and adjusting bolt (see diagram). This feature cuts down the bearing surface to a minimum and permits free rotation of the table even under a heavy load.

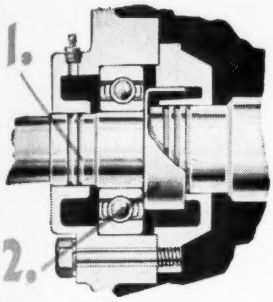
The 4-inch channel iron arm slides in and out of a trough formed by two Z-irons welded to a flat steel plate mounted to the inner side of the bench legs. A 22-inch maximum extension



Serial No. 1 . . . Crocker-Wheeler Motor, built in 1888.



Serial No. 1,000,000 . . . **SEALEDPOWER** (Cowl-Cooled) Motor . . . for all polyphase alternating current circuits, 2 to 15 horsepower.



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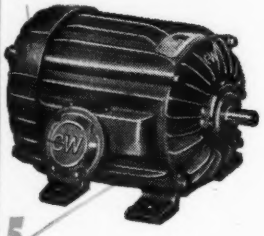

5.

SEALEDPOWER

Industry's Most Trouble-Free Motor

PRODUCED BY CROCKER-WHEELER'S 56 YEARS OF EXPERIENCE

CROCKER-WHEELER FEATURES:

1. Patented "Groovseal"—no greasing needed for at least a year. Grooves minimize grease loss. This seal makes bearing maintenance expense negligible. It permits use of softer grease, for better lubrication and longer bearing life. Airtight seal prevents dust or other foreign matter from entering bearings.

2. Crocker-Wheeler's exclusive De-Sludging Impeller. Automatically desludges . . . churns and distributes grease to bearings when motor is started.

3. Vacuum Impregnation—standard on *all* Crocker-Wheeler motors. Seals out foreign matter and moisture from each individual coil . . . fills all interstices, making windings a homogeneous mass . . . reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires either inside or outside of slot. (Photograph shows cross sections of baseballs, (left) after vacuum impregnation and (right) before vacuum impregnation. Note penetration of varnish to center of tightly-wound ball, making it a moisture-proof, homogeneous mass.)

SEALEDPOWER FEATURES:

4. Totally Enclosed Cowl-Cooled Construction resists corrosion. Protects against acid or alkali fumes, splashing or dripping liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

5. Fin Type Construction for non-clog ventilation and easy cleaning.

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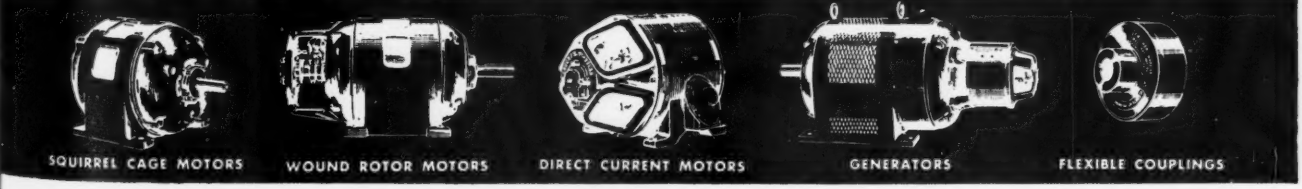
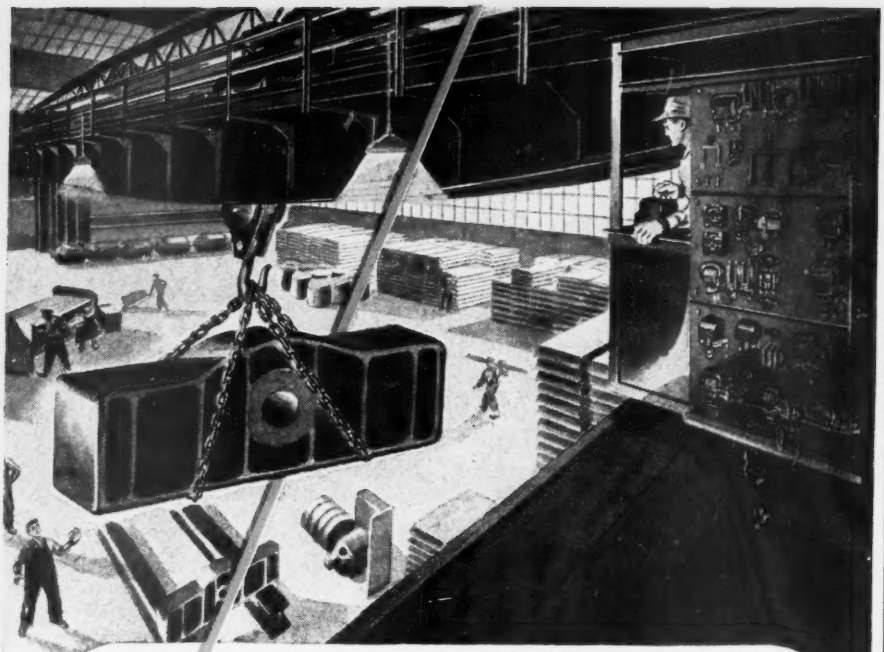


SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS



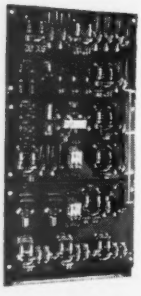
For the first Time

FIVE DEFINITE AND STABLE LOWERING SPEEDS OF CRANE HOISTS

on Alternating Current

It is no longer necessary for crane users to turn to direct current when they want maximum crane hoist performance. It is no longer necessary to put up with costly, troublesome load lowering brakes on alternating current crane hoists. Cutler-Hammer Engineers have solved this problem . . . the problem of getting 5 stable selective speed points—both hoisting and lowering; full dynamic braking; accurate inching; timed acceleration in both directions and timed deceleration for spotting a load . . . *all on alternating current.*

This new Cutler-Hammer AC Crane Control can be used with any standard slip ring crane motor and is available in drum type manual and magnetic types. Specify this outstanding engineering development for your next crane. Write today for full information. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.



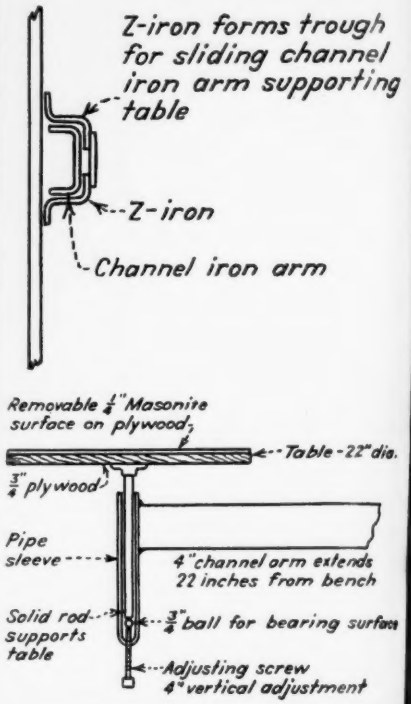
Engineering Excellence finds its Greatest Reward in the Respect and Confidence of those it Serves.

Control engineering ingenuity solved the long standing problem of how to get Crane performance on alternating current. This control panel of standard C-H units does the job with a standard AC motor.

CUTLER-HAMMER
MOTOR CONTROL
C-H

of the arm provides ample room for working on stators up to 25 hp.

The advantages of this device are obvious. The workman can remain in one position at all times with tools and materials handily spread out on the bench. When making coil connections, as in the above photo, he merely rotates the table as he progresses

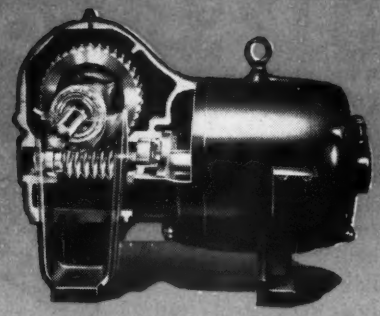

Z-iron forms trough for sliding channel iron arm supporting table
Z-iron
Channel iron arm
Removable ¼" Masonite surface on plywood
Table - 22" dia.
¾" plywood
Pipe sleeve
4" channel arm extends 22 inches from bench
Solid rod supports table
¾" ball for bearing surface
Adjusting screw 4" vertical adjustment

***CONSTRUCTION DETAILS** show method of supporting channel iron arm and turntable. Note anti-friction feature of ball bearing in table support assembly.*

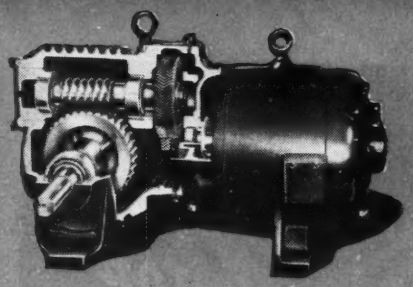
around the winding. Storage is no problem at all. When the work is completed, the turntable is removed from the supporting sleeve and stored on a shelf under the bench, the table top being flush with the side of the bench. The supporting arm is pushed back under the bench where the bench overhang protects the pipe sleeve.

SHOP SCOOTERS LIGHTEN THE LOAD

There is a very apparent lack of grunts and groans, sprained backs, pulled muscles and ligaments in the shop of the San Antonio Armature Works, San Antonio, Texas. It all results from an iron-clad rule laid down and rigidly enforced by H. S. Foster, shop owner. No employee is permitted to lift anything heavier than a standard ¼-hp. motor. A waste of time? Not when you consider the lost production that might occur from injuries sustained in pushing around heavy equipment. Consequently you see shop employees scurrying around with large motors, without the aid of cum-

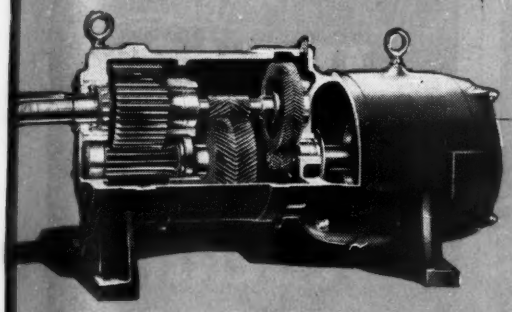


RIGHT ANGLE TYPE
RATIOS UP TO 72:1

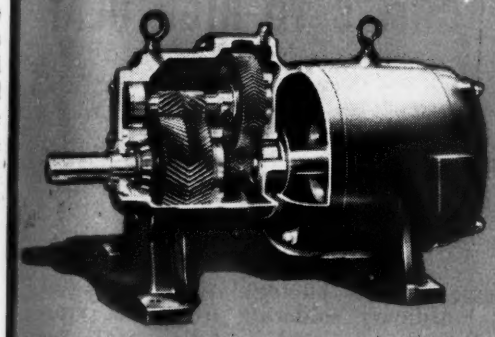


COMBINATION TYPE
RATIOS UP TO 432:1

MASTER GEARHEAD MOTORS



TRIPLE PARALLEL
RATIOS UP TO 120:1



DOUBLE PARALLEL
RATIOS UP TO 36:1

A COMPLETE LINE—Ratings from 1/10 to 100 Horsepower.

COST REDUCED by the elimination of bearings, couplings, chains and sprockets, gear trains or separate gear reducers —only one unit to mount—lower assembly costs.

COMPACTNESS—High reduction ratios secured in small space by using alloy steels, splined shafts and heat treated gears.

GREAT FLEXIBILITY—Master can readily modify either the motor or gear unit to fit exactly your individual requirements.

INTEGRAL CONSTRUCTION—In Master Gearhead Motors, both motors and gears are designed and built by one organization into a well balanced, clean cut power unit.

MOUNTS IN ANY POSITION — Master Patented Oil Seals and anti-friction ball and roller bearings as used in Master Gearhead Motors, permit the motor to be mounted in any position . . . horizontal, sidewall, ceiling or vertical with the gearhead either above or below the motor. However, the mounting position must be specified on the order so that proper oil gauges and vents may be arranged.

SIMPLIFIED DESIGN—More compact—less weight—permanent alignment—longer, reliable, trouble-free operation.

ANTI-FRICTION BEARINGS used throughout the entire unit.

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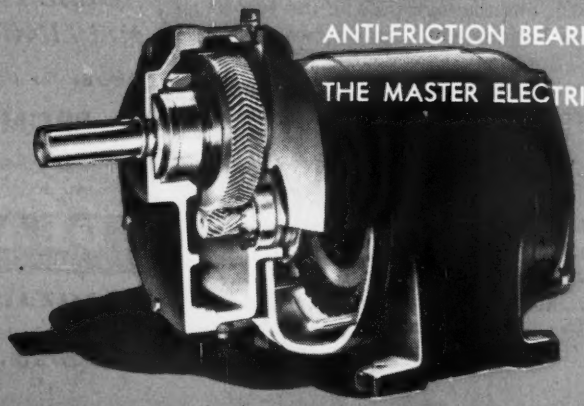
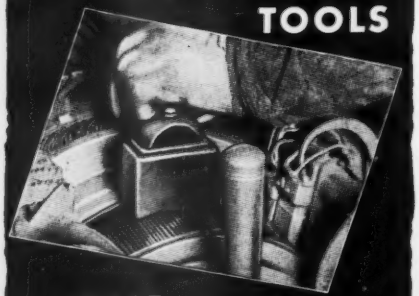


SINGLE PARALLEL
RATIOS UP TO 6:1

"tops"
For Keeping Motors in tip-top Condition

IDEAL MOTOR MAINTENANCE TOOLS



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Keep motors and generators on the job, piling up new production records. Refinish Commutator and Slip Ring surfaces to original efficiency without dismantling. Sizes and grades for all conditions.

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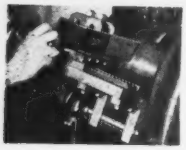

Used when surfaces are badly scored and out-of-round. Portable. Mount on Motor Frame —no disassembly.

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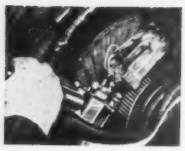

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bersome overhead hoists or monorail systems.

Foster's answer to material handling problems in his shop is a fleet of hand scooters graduated in size to handle anything from a ¼-hp. to a 100 hp. motor with the capacity of the largest scooter being one ton.

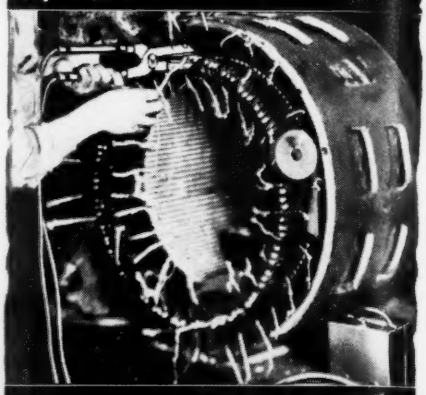
Simple in design and exceptionally easy to handle, the typical scooter consists of a rectangular or square steel platform (depending on the size of the unit) fastened to a steel frame which extends upward as an inverted "A" to form the handles. A set of old ball bearings (about the size of roller skate wheels) on a single steel shaft, centered under the platform, provides the mobile feature of the unit. The smaller scooters have a single ball bearing on each side for wheels; the larger units have double bearings on each side as wheels. A piece of angle iron forms a curb to prevent equipment sliding off the back of the platform.

HAND SCOOTERS with low center of gravity eliminate lifting and take the drudgery out of shifting heavy equipment in this shop.

The use of ball bearings for wheels, in addition to making it easier to push, keeps the platform hugging the floor and facilitates sliding the equipment on the scooter when it is tipped. When used, the scooter platform is tipped forward until it touches the floor; the equipment is slid on and centered on the scooter. For average sized equipment, one man can handle the scooter; heavy equipment requires two men.

These scooters have proved exceptionally helpful in shifting equipment from one part of the shop to another and in moving equipment up to the hoist for loading on delivery trucks. The scooters have been very economically built from excess and scrapped material. Their greatest value however has been the elimination of lost production due to lifting injuries.

SOLDERING Revolutionized



IDEAL "INSTANT HEAT" Thermo-Grip SOLDERING TOOLS

PART TOUCHED COMES TO HIGH HEAT INSTANTLY!

Ideal for soldering motor connections, soldering lugs, terminals, etc.

IDEAL "Thermo-Grips" are not just ordinary soldering irons, but *especially* designed soldering tools for specific hard and soft soldering jobs. Operating on the resistance heating principle, the part touched comes to a high heat, *instantly*. No preheating necessary. Safe—No open flame.

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PANTHER and DRAGON Friction and Rubber Tapes are constantly tested at the factory to ensure sufficient degrees of adhesion and fusion.

Fully meeting all the requirements of A.S.T.M. and Federal Emergency Specifications, PANTHER and DRAGON Friction and Rubber Tapes are being specified and used by electrical contractors who recognize the guaranteed performance of *factory-tested* tape.

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3. High Tensile Strength
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9. Excellent Tackiness
10. Colorful, Attractive Boxes

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FRICTION TAPE

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2. Substantial Fabric
3. High Tensile Strength
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5. High Dielectric Strength
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8. Excellent Tackiness
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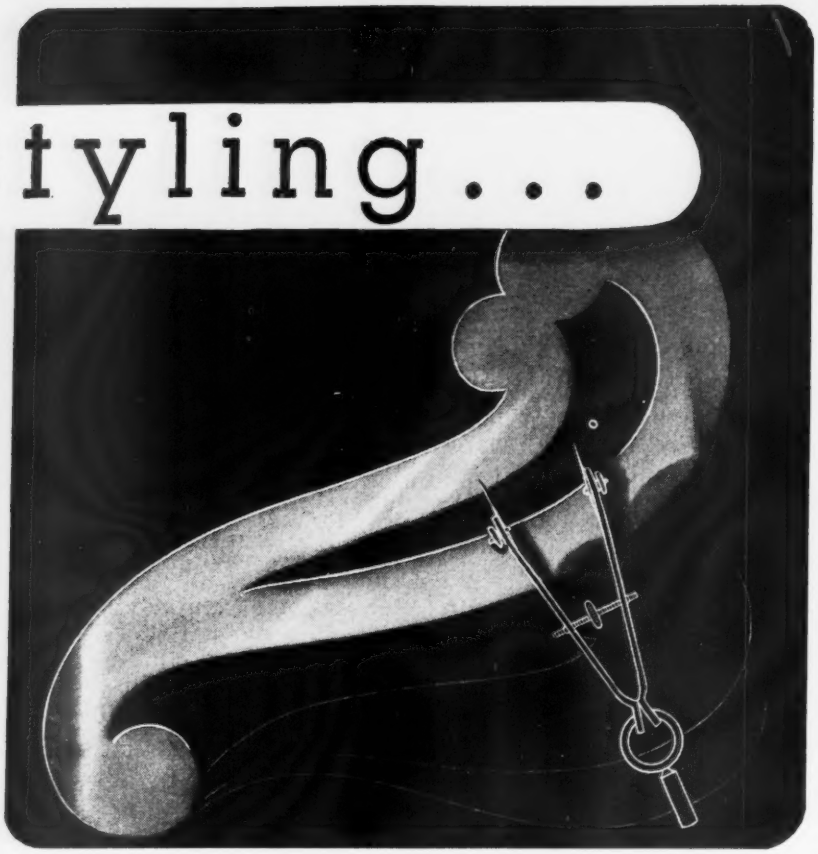
styling...



...key to customer acceptance

EVER SINCE electric door chimes were first introduced to the nation, Rittenhouse has recognized that smart styling must always be an essential factor in building and holding customer-preference.

It is natural, therefore, that Rittenhouse Chimes should consistently excel in this predominant characteristic of highest quality merchandise—a distinguishing mark of superiority immediately apparent to trade and public alike.

As we plan the post-war Rittenhouse line, we zealously safeguard this tradition. From among the topmost product designers in the country, we selected that one whose name and achievements rightly enjoy national preeminence. Sparkling new models, brilliantly styled by this recognized design authority, are now ready for production when the facilities of Rittenhouse are no longer required by the Armed Forces.

Again we say, the better door chimes of the future will be Rittenhouse-made. For that warranty of supreme satisfaction which has always been closely associated with the name "RITTENHOUSE", *plan* now with us for a highly successful and profitable post-war business.

THE A. E. RITTENHOUSE COMPANY, INC.
Honeoye Falls, New York

Rittenhouse
DOOR CHIMES

High Voltage for Gun Making

[FROM PAGE 54]

in from the substation "C" which is near to the office wing. In the basement, three 50 kva. lighting transformers are connected 440 v. to 120/208 v. to supply the entire office requirements. Three phase, 4 wire feeders are then carried to each of the main panels.

The 13,200 volt feeders supplying the proving grounds, where the Army and Navy each test their individual equipments, is part underground and part overhead construction. The underground feeder carries the circuits to a corner of the plant where a riser with three-bushing potheads brings the conductors to the overhead lines. The proving ground substations are each 75 kva. (3–25 kva. tubs) supported on channel iron between two poles using standard two-pole mounting specifications for lighting arrestors, fused-disconnects, grounds, primary and secondary bus, etc.

A number of safety features are provided at the proving grounds. One example is the interlocking circuits between the tunnel doors and the gun-barrel doors. To test the firing of the Bofors gun, its barrels must first be inserted through a set of doors before the gun can be locked into place for firing. The slugs then on being fired travel up through an underground tunnel several hundred yards long into a moving sand bank which prevents the red-hot missiles from piling up into each other.

Before the barrels can be thrust through the doors, however, the tunnel doors must be closed and bolted to prevent personnel from entering. As the locking bolt slips into place it actuates a limit switch which releases a latch on the gun barrel doors. This permits the barrel doors to be opened to insert the gun barrels for firing. As the barrel doors reach their full open position, another limit switch is actuated which operates a solenoid latch on the tunnel door preventing entrance of personnel into the tunnel during firing.

Another example of the safety circuits is the signal system on the target sand-moving equipment. If any of the motors in the conveyorized system stops, a "cease-firing" lamp, which is a red light in front of the gunner, flashes on to prevent damage from successive slugs piling into each other. Operating failures are relayed to the lamp circuit by contactors in the control panel.

JUST SUPPOSE!

by Barbara Brown

Olney High School, Philadelphia, Pa.

Note: Several weeks ago the United States Treasury Department and the Columbia Scholastic Press Association sponsored an editorial contest for the nation's high school students. Subject: War Bonds. Winner: 15-year-old Barbara Brown, a Philadelphia high school junior. In the interests of helping the Fifth War Loan Drive, now in progress, we are proud to print here the stirring message written by Miss Brown.

SUPPOSE *there were no tomorrows?* . . . Think about it for just a minute . . . No tomorrow for you, or your kid sister at home—or the brother who left for the Army yesterday. Did you ever think that we, who have had so few yesterdays, may have no tomorrows?

It *has* happened, you know. To Jack Feldman, and to Bob Ernest—and to fifteen other boys who sat in our classes just last year . . .

They will have no tomorrows. They died before they ever had a try at living . . . so that we here at home might have our chance.

There are millions who were asked to give up more than a double feature at the Earle . . . or a spiffy new pair of pumps for next week's formal. A soda is a pretty insignificant sacrifice, when you think of things like—

The kids in Russia, who live on a few ounces of cereal a day. *They've never seen an ice-cream soda.*

The Polish boys and girls, who would be in school right now, just as we are . . . *if there were any schools left.*

The French youths who've never had a hamburger when they were out on a date—or any other time, for that matter. They are old, very old . . . *older than you and I will ever be. . .*

There are millions of them . . . in Norway . . . Holland . . . Denmark . . . Belgium . . . They would stare in amazement if they could be here to see—

A jalopy painted bright yellow. "The Tin You Love To Touch" printed in big, green letters on the back.

A high school senior, uncomfortable in his first tuxedo . . . calling for his date, looking nervous.

Millions of things that we take for granted . . .

There is such a feeling of permanency in our tight little world. We'll go to school with the gang, today . . . and tomorrow . . .

BUT, WHAT IF THERE WERE NO TOMORROWS? There's only one way to be sure, you know—

Buy War Bonds . . . That's a simple little phrase. It's the American way of saying what we mean in a few direct words. *Buy War Bonds.*

Yes—you and everybody must buy War Bonds. We've *got to* buy more and more and more of 'em. Just get the idea into your head that your $18.75 might—just *might* end the war one-fifth of a second sooner. That maybe, in that one-fifth of a second, the boy next door could be on the receiving end of a bullet . . . Then you'll know that it's worth any small sacrifice you have to make!

We've got to keep on plugging, saving, convincing. Giving our pin money . . .

Tell everybody—sell everybody! We can't take no for an answer . . . Because we are buying *tomorrow—and tomorrow—and tomorrow.*

SPANG-CHALFANT

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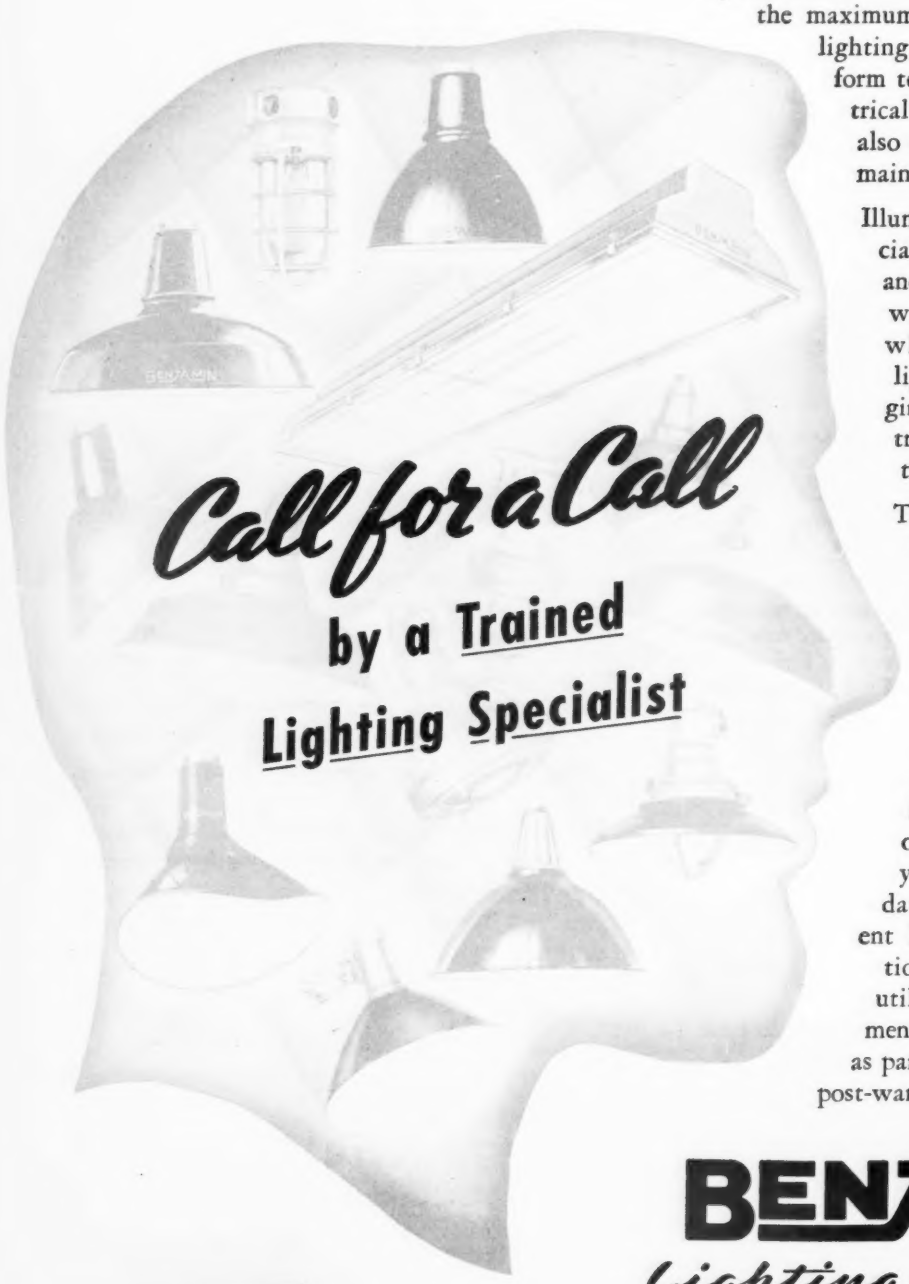

Call for a Call by a Trained Lighting Specialist

Lighting is a production tool that must meet the specifications set by the Seeing Task if it is to return the maximum on the investment. To secure such lighting, requires not only fixtures which conform to the most exacting mechanical, electrical and illumination specifications, but also the proper selection, installation, and maintenance of these fixtures.

Illumination engineers and lighting specialists connected with the electric light and power company serving you, or with the electrical wholesalers from whom you procure your Benjamin lighting fixtures, and the Field Engineers of this company, have special training in the science of seeing and the fundamentals of lighting practice.

They have in their *heads* a thorough understanding of the best application of the various types of lighting units available for the solution of your specific lighting and seeing problems.

These men work closely with your own plant and consulting engineers. Their experience and training is available freely, without cost or obligation on your part, to analyze your lighting and make recommendations for the improvement of present lighting for increased war production. Their services also should be utilized, now, to help in the development of a program of lighting betterment as part of your reconversion plans for the post-war period.

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Send for a copy of this FREE BOOKLET containing much valuable information on how to obtain best lighting results. With it will be sent complete information on how you may obtain the assistance of the Benjamin Field Engineer in analyzing the performance of your lighting and in making recommendations. Address Lighting Service, Benjamin Electric Mfg. Co., Dept. H. Des Plaines, Illinois.

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ENGINEERING • INSTALLATION • MAINTENANCE

Squirrel Cage Motor Starters—I

Across-the-line and reduced voltage starters both manual and magnetic, each have distinctive features to provide fullest utilization of motor starting characteristics and still meet driven load and power supply limitations.

THE squirrel cage motor has become by far the most popular choice in industrial drive practice. It is sturdy and rugged, and the absence of brushes and commutators or slip rings reduce maintenance to a minimum. This, added to its lower first cost, good starting and running characteristics, and higher operating efficiencies make it so economical that it is the universal choice in the majority of constant speed applications.

The four main types of motor design available have been classed according to the following torque and starting current characteristics.

A. Normal torque, normal starting current

B. Normal torque, low starting current

C. High torque, low starting current

D. High torque, high slip

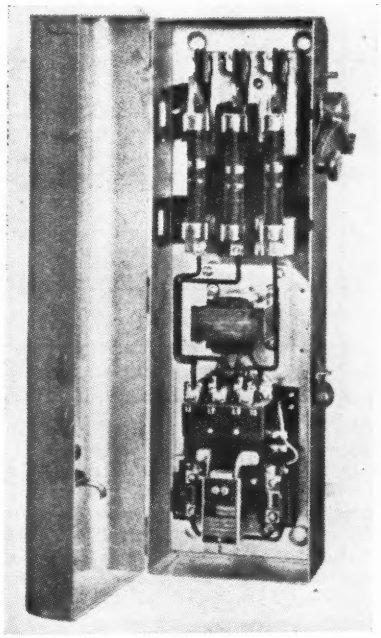
In the selection of the motor many factors figure into the final decision as pointed out in a previous article. Since one of the important factors in motor selection is starting torque, it must not be nullified by the selection of the wrong type starter.

Selection of Starter

The two important considerations in starter selection are namely (1) to provide enough torque to start and accelerate the motor without harmful shock to the driven load, and (2) to meet the inrush current specifications of the power supply facilities so that objectionable voltage dips are avoided.

Since starting and running torque requirements vary considerably, it is not always possible to select a motor that gives the best performance during both starting and running. Consequently, it is necessary to decide from projected duty cycles, which of the two are the more important. For instance, running efficiency can be sacrificed for better starting performance where duty is intermittent and starting is heavy and important. Conversely, where a motor runs for long periods at a time and starting efficiency is not so important, high running efficiencies can be obtained at the expense of high inrush currents. Therefore, the proper selection of starting equipment is important in both instances.

Two methods of starting squirrel cage motors are available to successfully meet the fundamental considerations involved in starter selection. The first is across-the-line starting, and the second is reduced voltage starting. Where the load can stand the shock of the high torque across-the-line start and where objectionable line disturbances will not be created, the former method may be used. Where starting torque must be cushioned or applied gradually, or where high current inrushes cannot be tolerated on the power supply lines, a reduced voltage method of starting may be required.



COMBINATION ACROSS-THE-LINE starter which consists of a fused motor circuit switch and a magnetic breaker for connection of motor leads directly across-the-line. Note the control circuit transformer mounted in the center.

Power Supply Limitations

At the time the squirrel cage motor first began to gain popularity, the power companies did not have the copper in their distribution systems to tolerate line disturbances caused by squirrel cage starting. In some instances the application of squirrel cage motors above a certain rating were ruled out completely, with slip-ring

A discussion of squirrel cage motor starting and running characteristics was given on page 55 of the August, 1943, issue of *Electrical Contracting*. The article was written with special reference to motor application under WPB order L-221. However, the motor characteristic data given there applies in any case to correct selection and application of squirrel cage motor drive.

Assuming that the motor has been selected to meet the starting and running characteristics of the driven load, starting equipment must now be provided to bring the motor onto the line and up to running speed with due consideration to load shock and power supply limitations.

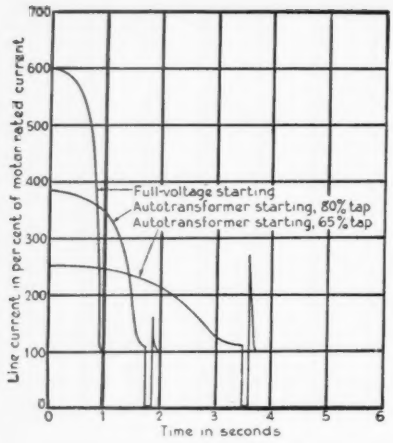

Line current in per cent of motor rated current
Full-voltage starting
Autotransformer starting, 80% tap
Autotransformer starting, 65% tap
Time in seconds

Fig. 1a—Accelerating current of a squirrel cage induction motor drive. Note the second current peaks that occur when the auto-transformer starter is thrown from start to run position.

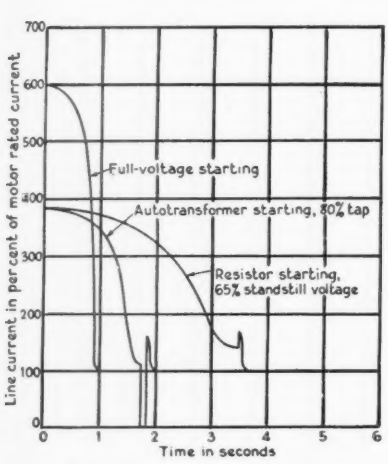

Line current in per cent of motor rated current
Full-voltage starting
Autotransformer starting, 80% tap
Resistor starting, 65% standstill voltage
Time in seconds

Fig. 1b—Note the inrush current taken from the line is the same for both the compensator and the resistance starter. However, one supplies 80 percent voltage to the motor terminals while the other provides only 65 percent.

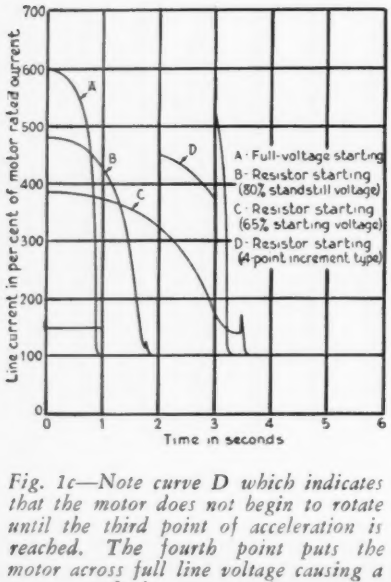

Line current in per cent of motor rated current
A
B
C
D
A - Full-voltage starting
B - Resistor starting (80% standstill voltage)
C - Resistor starting (65% starting voltage)
D - Resistor starting (4-point increment type)
Time in seconds

Fig. 1c—Note curve D which indicates that the motor does not begin to rotate until the third point of acceleration is reached. The fourth point puts the motor across full line voltage causing a final current peak.

motors used in lieu of this more popular drive. Across-the-line starting was generally limited to 5 hp.

However, the growth of the power industry, providing stable, high capacity lines with plenty of transformer and generating capacity to back them up, now permits across-the-line starting of motors as large as three and four hundred horsepower in certain areas.

The objectionable feature to across-the-line starting is the voltage drop caused in the lines due to the high current drawn during starting. Depending on motor design, these inrush currents may be from four to ten times normal full-load current. For a Class A motor, inrush currents are about 600 percent. For class B motors inrush current is about 500 percent of motor full-load current.

Thus it can be seen where transformer capacity and wire sizes are small, line voltages suffer serious dips even when small motors are started across-the-line. Voltage dips of only a few percent can cause objectionable lamp flicker. Larger voltage dips may cause other motors on the line, especially synchronous motors, to drop out of step and stall.

In large plants where the installed capacity is great and where feeders are heavy, very large motors may be started across-the-line with little or no evidence of these objectionable voltage variations.

Power Company Rules

In the majority of cases, power company rules might go something like this. During the starting and accelerating period of squirrel cage motors, no more than 250 amperes at the utilization voltage may be applied to the line

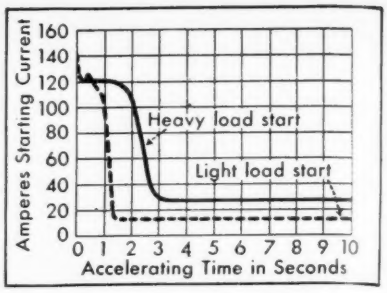


Fig. 6—Typical curves obtained with across-the-line starting of a 10 hp. squirrel cage motor. Initial current inrush is about the same with both heavy and light load. Acceleration time is much less under light load conditions.

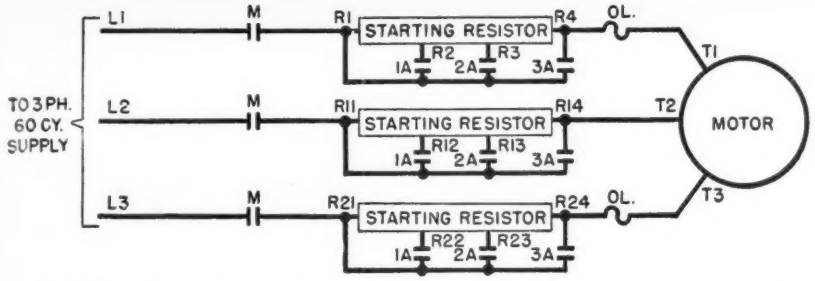
at minimum intervals of one second. This does not mean the 250 amperes is the maximum. It means that 250 amperes may be applied for one second; 250 amps. more (or 500 amps.) during the second second, and so forth. Thus, in starting a large motor with say a 700 ampere inrush, a three-point resistance starter would be required. If it were a hard-starting load, all the resistance of the starter might have to be cut out before the rotor began to roll; that is, full 700 amps. might be required to obtain sufficient starting torque. But power company regulations would still be met. The first starting point would limit current to 250 amperes for one second; the second contactor would operate, reducing the resistance to allow another 250 amps. to flow (or 500 amps. total) for another second; the third point would cut out all resistance permitting the full inrush of 700 amps. to flow in the windings, and the motor would start.

Network systems of 120/208 v., where both power and lighting circuits are taken from the same feeders, are more subject to objectionable lamp flicker than are the radial systems of

COMPARISON OF STARTING TORQUES AND CURRENTS
Under various starting conditions*

Applied Voltage		Motor Current		Line Current				Starting Torque
				Resistor Starting		Compensator Starting		
Volts	Percent	Amperes	Percent	Amperes	Percent	Amperes	Percent	Percent of F. L. Torque
440 (Across-the-line)	100%	450 (Same as line current	100%	.....	....	.....	....	160%
352	80%	360	80%	360	80%	288	64%	102%
286	65%	292	65%	292.5	65%	189	42%	68%
220	50%	225	50%	225	50%	112	25%	40%

* 60 H. P. 1800 R. P. M. 3ϕ 60 cy. 440 V. 75 F. L. Amps. Class A Motor.



***ELEMENTARY** diagram of a four-point resistance starter. Motor starts with all the resistance in the circuit. Then 1A, 2A, and 3A close consecutively shorting out the starting resistance step by step. A timing relay is generally used to close the shorting contacts at predetermined intervals.*

distribution where light and power are fed from separate transformers and secondary distribution. Because of the proximity of circuits in the network system, voltage dips are more effective, whereas in radial distribution, these dips are "cushioned" or attenuated, because of the distance to transformers, and in the transformation itself.

It has been estimated that about 95 percent of squirrel cage motor drives are below 200 hp., and it may be safely stated that the vast majority of these are line-start motors.

Reduced Voltage Starter

Wherever across-the-line starting currents of squirrel cage motors are likely to exceed local power company restrictions or interfere with plant operations, a reduced voltage starter must be used. Of the four types of reduced voltage starting available, resistance and auto-transformer are preferred and the most widely used.

Reactor starting is occasionally used on large motors, and in those cases, most frequently at high voltage (2200 volts or above) where large oil circuit breakers are necessary to provide sufficient current interrupting capacity.

Wye-delta starting is quite common in Europe but seldom used in the U. S. The starter connects the motor windings in wye for starting and delta for running. On the wye-starting connection, the current and the torque developed by the motor are reduced to one-third of their full voltage values. Very often this low starting torque is insufficient.

The auto-transformer starter (sometimes called compensator) is the most popular type of reduced voltage starter. It has the advantage of permitting the motor to develop more starting torque with less current drawn from the line. This is shown in the accompanying table. The motor torque and the current drawn from the line (not the motor current) vary as the square of the voltage applied to the motor terminals. For example, if the auto-transformer starting taps are set to give 80 percent full line voltage to the motor, then the motor current will be 80 percent, the line current will be 64 percent and the motor torque will be 64 percent of full load torque.

The compensator, however, has the disadvantage of producing two disturbances instead of one as by other methods of starting. One disturbance is created in making the initial starting contact, and a second in making the transfer from "start" to "run"; that is, from reduced voltage to full voltage. This second transient is due to opening the circuit during transfer, which does not occur when resistance is short-circuited in the resistance starter. The auto-transformer starter normally accelerates the motor to nearly full speed on the reduced voltage connection and then is immediately reclosed into the running, full voltage position.

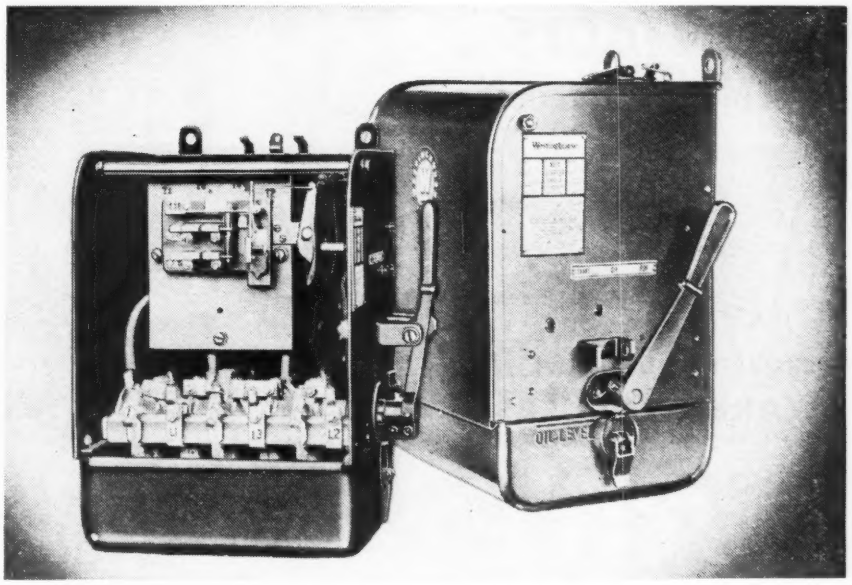
The resistance starter has the disadvantage that current drawn from the line is reduced in direct proportion to the voltage applied to the motor terminals with the torque being reduced in proportion to the square of that voltage. For instance, if the voltage applied to the motor is reduced to 80 percent by the insertion of starting resistance, the motor torque is reduced to 64 percent, but the current drawn from the line is the same as the motor current which is 80 percent and not 64 percent as in the case of the compensator-start.

However, it does have the advantage that a number of reduced voltage starter steps can be obtained economically to meet most limitations and restrictions. Furthermore, the circuit is not opened on transfer from start to run since the resistance is short-circuited out of the circuit.

An additional advantage lies in the fact that with the resistor-start, the motor torque increases as the speed of the motor increases. This is a result of the current decreasing, which decreases the voltage drop across the resistor, which in turn increases the terminal voltage thus increasing the torque. This is a definite advantage in providing a smoother acceleration.

Resistance starters can be obtained with fixed or variable resistors. The smoothest acceleration is obtained by the variable resistor type which uses a column of resistance discs. As the discs are slowly compressed the total unit resistance decreases giving a stepless build up of current and starting torque to accelerate the motor. At the end of the compression stroke, a magnetic running switch is automatically closed connecting the motor directly to the line.

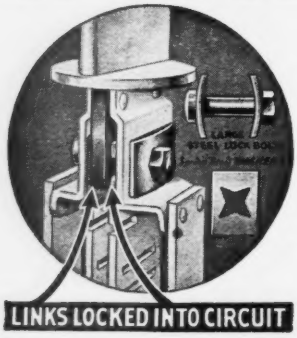
This type of starter can be obtained for either manual or full-automatic magnetic operation. In manual operation, the operator applies compression with a hand lever. In magnetic opera-



***MANUAL** non-reversing auto-transformer starter to keep current inrush within limits. Both low voltage and thermal overload protection is provided by a magnetic holding coil for the run position of contactors. Interlocked starting sequence prevents accidental starting in run positions.*

Troubles End with COOL FUSES

WARE HI-LAG



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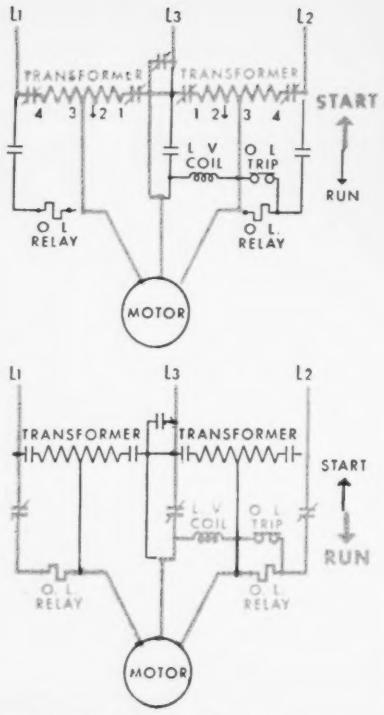
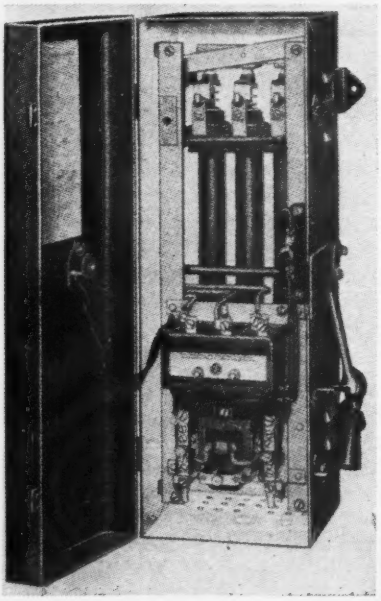
WARE Renewable HI-LAG FUSES



ELEMENTARY DIAGRAM of an auto-transformer starter showing the position of the contacts first in the starting direction and then in the running direction. With this plan an open-circuit condition exists between start and run.

tion, the compression is applied by a fulcrum-and-lever scheme with a d.c. solenoid supplied by a small built-in, dry-type rectifier (dashpot retarded) supplying the driving force.

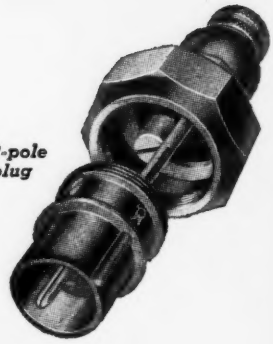
In the article to follow, each specific type of starter both manual and magnetic is illustrated and discussed with particular reference to ratings and distinctive features.



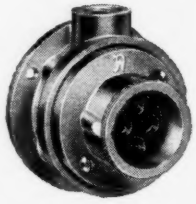
MANUAL compression resistor starter for a smooth stepless acceleration. Pressure is applied manually to the columns of resistance discs until finally the magnetic breaker operates connecting the motor terminals directly across-the-line short-circuiting the disc assemblies.

FUSIBLE

plugs and receptacles



Type FP 2-pole fusible plug



Type LRA receptacle with threaded housing

built for heavy duty service

General Purpose plugs and receptacles are heavy duty types with round prong contacts mounted in molded insulation and with cast metal housings of rugged construction to withstand hard use. The complete range of types includes fusible plugs, cable connector plugs and receptacles, and receptacles in many housing types with conduit fitting bodies in standard styles and sizes. Fusible plugs on extension circuits will isolate a defective device without interruption to other equipment. General Purpose plugs and receptacles are available in 1, 2, 3, 4, and 5 poles, ratings 30, 60, 100, 200 amperes. Write for Pylet Catalog with complete listings of all types.

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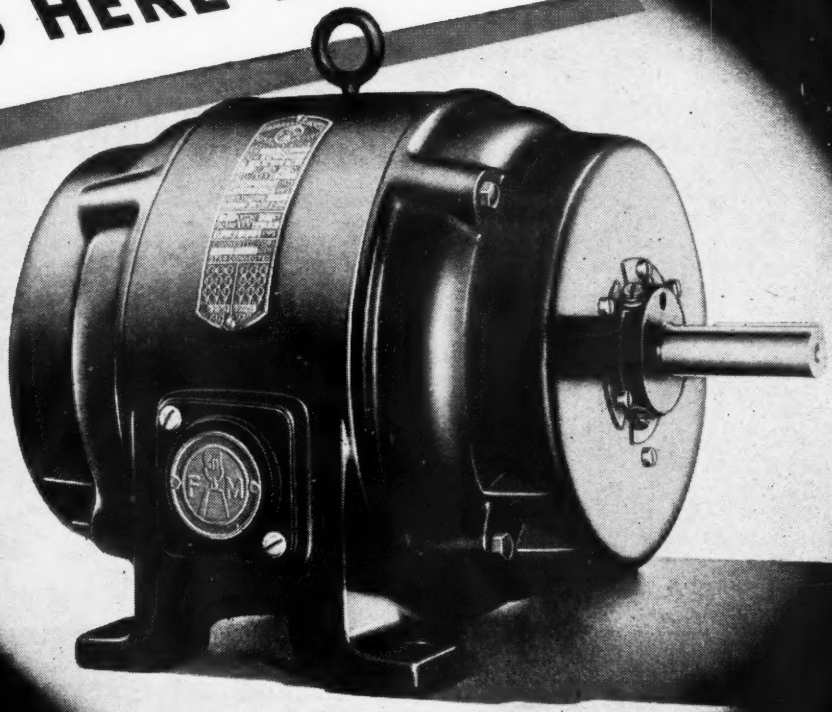

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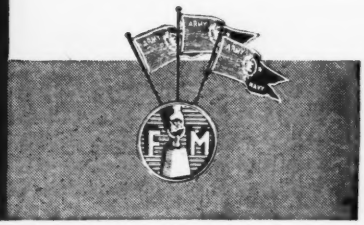
Motors



DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index.

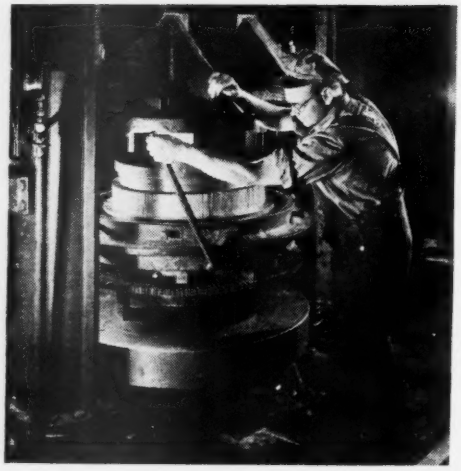
K-4

Commutator Maintenance

Thoroughly understanding this most vital part of the machine makes it easier to maintain. Keep commutator surface clean and free from dirt and oil; wipe frequently with a piece of dry canvas.

◀ COMMUTATOR FABRICATION begins with brazing of "necks" at temperature of 900 degrees F., making perfect contact. Necks less securely joined sometimes break off from vibrations in operation. Repair should then be made by fusing, not soldering, if further breakdown is to be avoided.

BARS AND MICA are placed on ▶ commutator ring, the assembler being careful to keep oil or dirt from between them. If commutator is ever disassembled, the maintenance man should be equally careful to keep parts free of foreign materials to avoid slow burning action of oil and dirt.



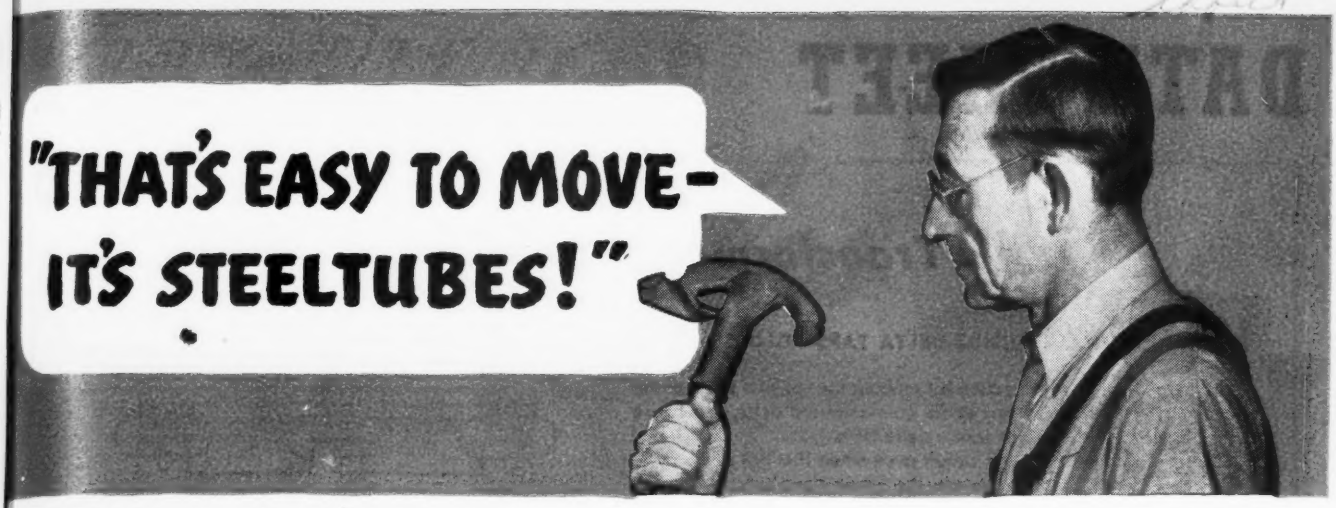
◀ SECRET OF PRODUCING a smooth-operating commutator is largely in seasoning. After tightening in this press, a commutator passes through four cycles of stationary seasoning, and later, rotary seasoning. Unnecessary tightening by inexperienced persons will disturb smooth operation.

LAST STEP IN ASSEMBLY—lowering of seasoned bar on sleeve and ring—is last chance to check perfect cleanliness of parts. V-ring mica must be carefully scarfed to get uniform thickness throughout circumference. Bakelite tube is inserted over steel sleeve to protect inside of commutator bars. ▶

◀ ONE MAN using 18-inch wrench gives medium size commutator final tightening. This takes up all of the slack. In servicing commutator, no greater pressure should be applied. Extra pressure causes mica to slip, and eventually bolts stretch without further tightening the commutator. If bolts must be adjusted, turning of commutator should follow.

A ROTATING BLADE undercuts ▶ full width of mica between copper segments, leaving no mica on sides of bars (to cause poor commutation). In maintenance, if mica becomes higher than copper segments, undercut with an undercutting tool or milling tool making sure to cut out full width of mica. After undercutting, sand off copper burrs.

Information from Allis-Chalmers Mfg. Co.



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Here is a bending manual that illustrates how easy it is to bend E.M.T. with the ELECTRUNITE and Hickey Benders as well as the Mandrel Spring.

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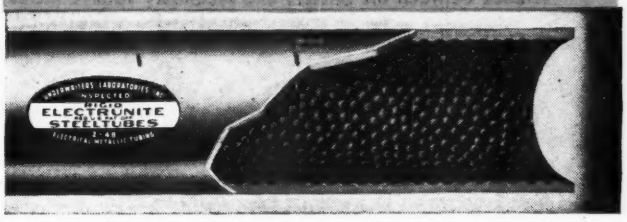
The knurled inside finish of ELECTRUNITE STEELTUBES cuts wire pulling effort up to 30%.



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DATA SHEET

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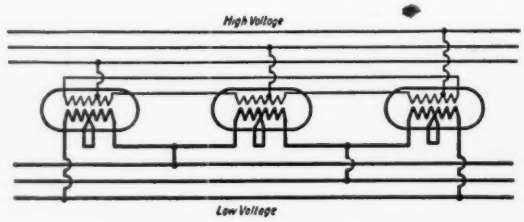
T-5

Transformer Connections

12 THREE-PHASE: INSIDE DELTA TAPS—CLOSED DELTA

The purpose of this connection is to permit the use of a tap without re-connecting the transformers at the corners of the delta. There are two objections to the use of inside delta taps.

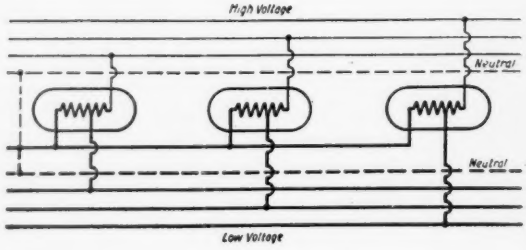
1. All of the winding is in circuit even when it is not needed.
2. There is a phase shift between the primary and secondary voltages, which would not be present if the straight delta connection was used. This shift in voltage is objectionable if the transformer is to be paralleled with a straight delta-delta transformer.



12

13 THREE-PHASE: FOUR-WIRE, STAR—STAR WITH AUTO-TRANSFORMERS

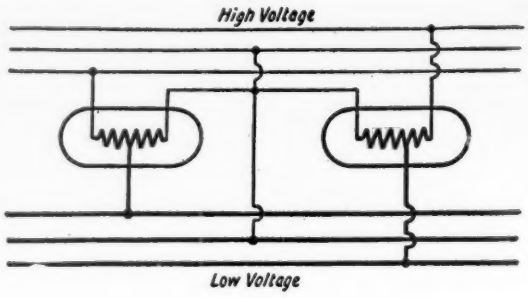
In this connection the high and low-voltage windings are electrically connected together, and for this reason the low-voltage side is the same voltage relative to ground as the high-voltage circuit. The material in the auto-transformer is less than that in a two winding transformer, transforming the same power. The saving in material is quite large when there is but a small difference in the primary and secondary voltages, and the saving becomes less and less as the difference between the primary and secondary voltage increases.



13

14 THREE-PHASE: THREE-WIRE—OPEN DELTA WITH AUTO-TRANSFORMERS

In this connection the high and low-voltage windings are electrically connected together, and for this reason the low-voltage side is the same voltage relative to ground as the high-voltage circuit. The material in the auto-transformer is less than that in a two winding transformer, transforming the same power. The saving in material is quite large when there is but a small difference in the primary and secondary voltages, and the saving becomes less and less as the difference between the primary and secondary voltage increases.



14

15 4000 TO 2300 VOLTS BY USE OF STANDARD 2-WINDING TRANSFORMERS

This diagram gives a method of hooking up three standard 2300-volt transformers to transform from 4000 to 2300 volts, three-phase.

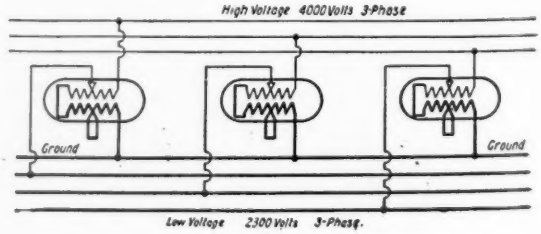
Find the middle point of the high-voltage winding which is generally available either at the terminal block or on a crossover lead of the coils. Connect the left-hand, high-voltage lead to this point and connect outside the case as indicated.

Connect inside the case the left-hand end of high-voltage winding to the left-hand end of the low-voltage winding as indicated.

Connect low-voltage coils in series as indicated. Follow schematic diagram. Note that actual voltages of 4730 and 2790 bear the same ratio as 4000 and 2300; therefore, if 4000 only is impressed then the required 2300 volts will be delivered.

Transformers over 50 kva. are not adapted for connection in this manner for motor starting.

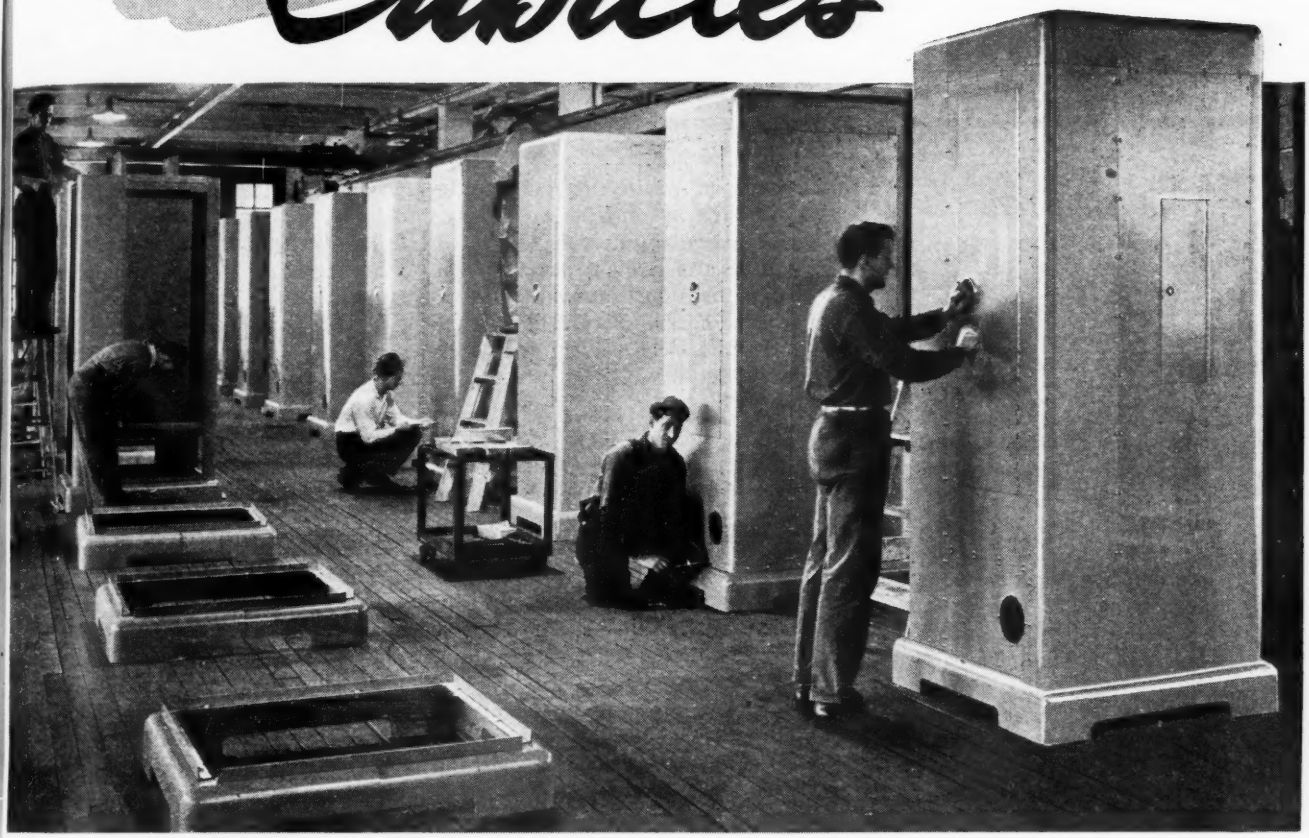
Caution — The neutral point must be grounded. Do not impress a higher voltage than 4000 volts, as the insulation is not built to withstand higher stresses.



15

Information obtained from Westinghouse Electric & Mfg. Co.

KIRK AND BLUM Cubicles



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READER'S QUIZ

NOISE IN MOTOR

QUESTION 133. I have a 75 hp., 440 volt, 3 phase, 60 cycle motor that has just been rewound and reconnected to run 514 rpm. instead of 600 rpm., its original speed. As yet we have not put the load on it but have been running it idle. It seems to run all right and the speed is 516 rpm. but it has a noise in it I never heard before. The regular a.c. hum is there and is constant, but there is another sing to it that tends to build up in volume and stop with a loud "thump," that jars the motor and the timbers it sets on. This thumping is intermittent, occurring once or twice a second or once or twice a minute. The air gap is uniform and there is 3/16-in. end play, but the rotor does not move end ways when the noise occurs. It has ball bearings and seems to be in good shape.—J.F.

A. TO QUESTION 133. You can determine whether this noise is electrical or mechanical by bringing the motor up to speed and then disconnecting it from the line. If the noise remains it is due to a mechanical defect.

The end play should be removed and the rotor centered in the stator so there will be no end pressure to cause heating. Also, check that the bearing is not turning in the housing or on the motor shaft.

If the bearing fits loosely in the housing or on the shaft and the rotor is not centered in the stator, it will have a tendency to bounce against the end causing a loud noise and jarring effect. Rough balls or dirt in the bearings will also cause a lot of commotion.—R.G.L.

A. TO QUESTION 133. I believe this trouble to be in the ball bearings which appear to have one or more flat balls. Ball bearings in this condition will whine due to the flat balls sliding instead of rolling. Then at irregular intervals, they will roll a little after which they will jam again and this is the cause of the thump. Remove the bearings, wash them thoroughly with a clean solvent and check for flat balls.—S.S.P.

A. TO QUESTION 133. The motor is hunting, which means that you have about the same number of rotor spaces as poles, or one can be divided equally by the other. It therefore goes up to above and drops below synchronous speed continually until it rests on this speed when it loses torque, thereby causing the music and knock.

Change the rotor, and the motor will run correctly. The only time we get torque is when the rotor slips past the magnetic field.—H.S.

BROKEN END RINGS

QUESTION 134. We recently *opened for inspection and cleaning a 50 hp., 1750 rpm. totally enclosed, squirrel cage induction motor and found the end ring on both ends of the rotor broken into several pieces. We have been unable to determine the cause of the end ring breakage. The motor was operating up to the time it was torn down for inspection so we are unable to tell how long the rings have been broken. If anyone has had a similar experience we would appreciate having his ideas on the cause of such breakage.—R.C.M.*

A. TO QUESTION 134. We have experienced similar trouble with the breakage of rotor bars and end rings which we attribute to the vibration of bars which were loose in the rotor core. This trouble has been remedied by sand blasting the rotor to thoroughly clean it and then dipping in a good quality of baking varnish. Two or three coats, well baked between dipping, will anchor the bars securely in the rotor core and eliminate the vibration.—B.C.M.

A. TO QUESTION 134. The motor was probably used for duty requiring frequent starting or reversing under load. Such service overheats the squirrel cage windings of standard motors, particularly in spots along the end rings due to variable contact resistance causing non-uniform current distribution therein.

The motor manufacturer can furnish rotors specially designed for such unusual service. The end rings will probably be made of brass or high-resistance alloy with increased volume to obtain the reqired conductance. The greater volume of end ring material provides the necessary high-heat storage capacity to keep down the squirrel cage winding temperatures.—G.I.S.

A. TO QUESTION 134. I have had three or four motors 5 to 20 hp. give similar trouble breaking the rotor bars about two-thirds the way round at both ends, but not the rings.

We put our trouble down to excessive vibration as in all cases the motors were gear connected to bucket elevators.

Your motor must be very lightly loaded as these broken rings should cause the motor to lose speed.—W.R.T.

SELECTING CONDENSER

QUESTION 135. Can someone tell me how to select the proper type and size of condenser to be used to reduce arcing of relay contacts controlling d.c. inductive loads, such as small motors, electric brakes, solenoids, etc., on 110 and 220 volts d.c.? What condenser for bells and signals on a 6-12 volt battery system?—H.R.S.

A. TO QUESTION 135. The amount of arcing is dependent upon several variables, including: 1. Speed of opening of contacts; 2. Current flowing; 3. Amount of "inductance" in the inductive load, which includes amount of iron, number of turns of wire, grade of iron, etc.; 4. Voltage; 5. Material of which contacts are made.

Without going into the very technical method of considering all the above in order to determine how much energy must be absorbed by the capacitor, the simplest method is to obtain a few sizes of capacitors and do a little experimenting. Connect one or more capacitors across the contacts and determine the combination that will give the most freedom from sparking, consistent with the lowest total capacitance that will be satisfactory. One capacitor of the correct size then can be substituted for the total combination. For the smaller sized relays, capacitances of ½ to 1 mfd. should be sufficient, but larger sizes will be necessary on the larger values of inductance and/or higher speed relays. Capacitor may be of any standard type but should have a voltage rating at least twice that of the circuit voltage. If electrolytic type are used, proper polarity of capacitor (condenser) should be used. Red lead is usually positive.—L.R.B.

A. TO QUESTION 135. I would use a .5 mfd. for the 6 to 12 volt system, although bells seem to last 5 to 10 years without condensers. For 110 and 220 volts, I get good results by using oversize quick-make-and-break switches or relays. I therefore consider condensers a useless expense.

If I should care to get still better results, I would use auxiliary carbon to carbon contacts, or copper to carbon contacts as used on elevator controllers.—H.S.

TO CHECK CIRCUIT BREAKERS

QUESTION 136. How do you check the condition of all parts of a sealed circuit breaker? I am sure that they cannot stand an unlimited number of openings at their peak ratings.—H.S.

A. TO QUESTION 136. Modern breakers with arc quenchers, if installed where short circuit current cannot exceed the rupturing capacity of the breaker, will repeatedly rupture load currents without damage. A good test is to pull a phantom load through

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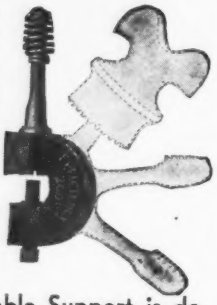

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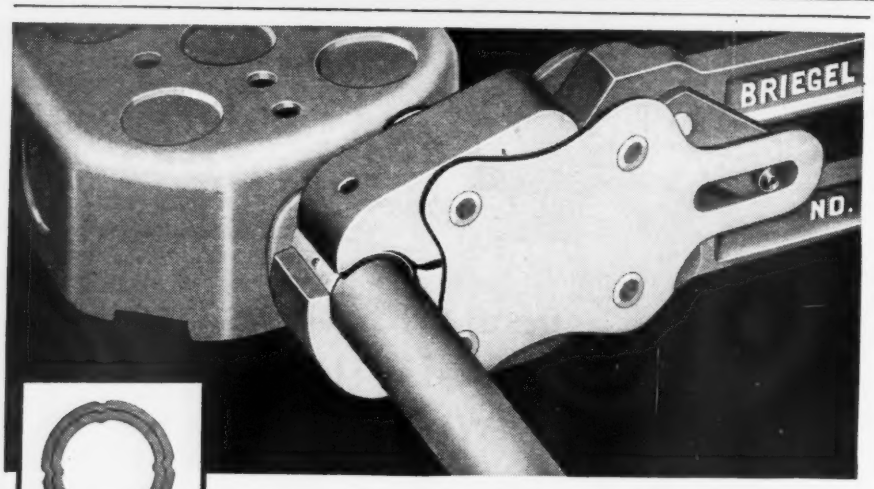

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its contacts equal to about 15 percent above its rating and see if there is unusual temperature rise. Also if instruments are available the contact resistance can be measured and poor contacts thus detected.—E.J.K.

TESTING CABLE INSULATION

QUESTION 137. I would like to hear from readers who have had experience in the testing of cable insulation both single and three conductor and with various types of insulation, such as lead sheath, paper insulated; types "R", "RA", and "RP" rubber; also VC insulated conductors.

I am especially interested in Megger readings on the above mentioned types of wire and cables at various temperatures, and would like to have recommendations as to just what is considered a satisfactory reading at specific temperatures on runs in conduit and underground cables.—R.L.M.

A. TO QUESTION 137. There are so many variables in cable installations that the information requested by R.L.M. is not available in usable form for Megger testing. For the past several years, the writer has been responsible for the installation of many large power and industrial cable installations and has been able to keep out of trouble by sticking to the one meg. minimum on low voltage jobs and supplementing the Megger test with a high potential test in accordance with the A.I.E.E. standards whenever possible on 2300 volt and higher installations. One must bear in mind that there is no relation between the insulation resistance obtained by the Megger and the dielectric strength as measured with a high voltage testing transformer. However in either test, the phase wires not under test should be shorted and grounded whether using three conductor cable or single conductor cable in order to make sure there is no fault between conductors.

In Megger testing, the important item to remember is that a single Megger reading, whether it is 10 megs. or 1000 megs. is of little value in judging the true condition of the cable. It is only by comparative readings taken over a period of time that enables one to judge the true condition of the cable. In order to eliminate the human element in routine Megger testing, it is suggested that a motor driven Megger be used so that a test of at least five minutes duration can be applied to all

important cables. This length of test is necessary in order to be sure that the cable is fully charged. The Megger handbooks published by the manufacturer give much valuable information on how to set up routine test charts etc. which when used along with plain old fashioned horse-sense, will be of great value to the maintenance man.—R.E.

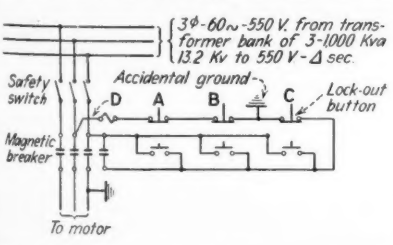
A. TO QUESTION 137. A test on a line made every three months for a period of five years, giving a reading of 10 megs all the time, will be better than a reading of 100 megs for five years, and then dropping to 25 megs either suddenly or gradually. In the first case, the insulation leakage was spread all over the cable, while in the second case, it was high quality insulation, whose leakage increased because there is something at one spot like a moisture path between conductors or between the conductors and the ground. One meg is good for 110-220 volts. For 440 volts, use 10 megs or more.

Many engineers figure 1 meg per 1000 volts. The temperature affects readings in the following manner. 90 megs at 30° C. will be 10 megs at 60° C. approximately. You also will have to wait between one and five minutes before taking a reading to charge the cable, using the same length of time whenever the test is made. Caution: After the reading, discharge the cable.—H.S.

Can you ANSWER these QUESTIONS

QUESTION A6 We have several long conveyors in our mill, controlled by magnetic switches and pushbuttons. The pushbuttons are regular start and stop type with lock out feature marked "safe" when in the locked out position. However the motors have at times started and nearly caused severe accidents.

The cause of the starting has been traced to the grounding of a control wire, as per sketch, at a point between the



station "C" and the holding coil of the magnetic switch.

We have a bank of ground indicating lamps (consisting of five 10-watt, 115-volt lamps in series) from each leg to grounded neutral. These lamps have been disconnected and the magnetic switches

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will still operate with no metallic return.

We have also tried connecting the coil to ground at point "D" in the sketch instead of the line wire. This is not very satisfactory as the low voltage will cause a magnetic hum, and often drop out entirely.

Repairmen have been instructed to open the safety switch before working on the conveyor, but some of the stations are quite a distance from the safety switch so they frequently use only the lockout buttons.

Is there any way to eliminate or neutralize this condition to make the lockout station safe?—W.C.M.

QUESTION B6—In the small capacitor type motors what is the main function of the capacitor and how is the capacitor size determined?—W.E.J.

QUESTION C6—Can your readers tell me how to energize a selsyn receiver without disturbing other receivers or the sender on the same system? Heretofore I have always stationed a man at each of the several units to hold them from spinning while the entire system was energized, but I would like to know how this could be made a one man job.—G.I.S.

QUESTION D6—I have tried to find some information from various places whereby one can figure what size capacitors to put on an a.c. line to help the power factor. When one has a certain size of induction motor load and knowing or suspecting the power factor to be low how do you determine what size capacitor to install?—C.A.B.

QUESTION E6—I have been wiring homes and farm buildings for 23 years, but have never run across one like this. Farmer here has yard light controlled by two 3-way switches, one in kitchen, one in garage. With kitchen light fuse in place, both three-way switches operate normally, and light the yard lamp. But upon removing the kitchen light fuse the yard lamp goes on and neither three-way switches will operate it until the kitchen light fuse is replaced. The current is 110-volt, 60 cycle, a.c. There is also a wall switch controlled lamp in garage. What's wrong?—R. J. W.

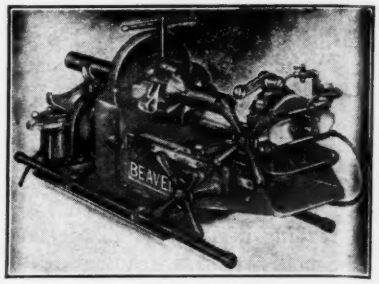
QUESTION F6—Here is a problem that came up the other day. I have a fan driven at 3600 rpm. by a 50 hp. motor direct connected to motor shaft. What hp. motor at 1800 synchronous speed will be required to drive this fan at 3600 rpm. using proper counter shaft and belting to increase the speed?

Does the speed of driven or driving apparatus have anything to do with hp. rating of such equipment?—S.M.K.

PLEASE SEND IN YOUR ANSWER BY JULY 1

The A-B-C of . . .

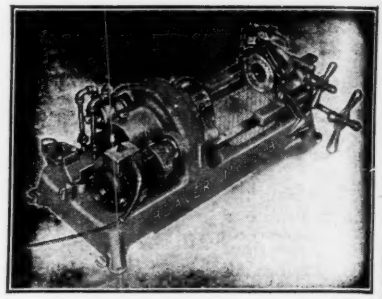
Pipe and Bolt Machines!



Beaver Model-A

A high-speed heavy-duty deluxe Pipe and Bolt Machine. Range 1/8 to 2-inch-up to 12-inch with geared tools and drive shaft. Bolts, 1/4 to 2-inch. Wt. 415 lbs.

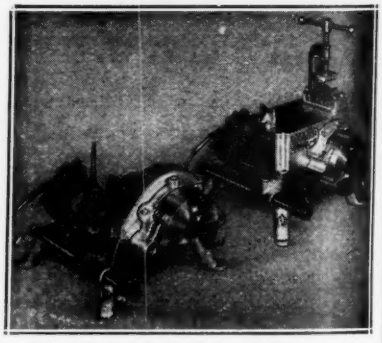
Write for Bulletin A



Beaver Model-B

A light-weight utility Pipe and Bolt Machine combining many features of Model-A with the easy portability of Model-C. Range 1/8 to 2-inch up to 8-inch with drive shaft and geared tools. Bolts up to 1 1/2-inch. Weight 280 lbs.

Write for Bulletin B



Beaver Model-C

A STURDY LITTLE POWER UNIT Converts hand pipe tools into power tools from 1/4 to 8-inch. Threads 8-inch in 6 minutes. Threads bolts up to 1 1/2-inch. Two men can work at the same time without interference. Weight 150 lbs.

Write for Bulletin C

Write for new Tool and Machine Catalogue—Just off the press

BEAVER PIPE TOOLS

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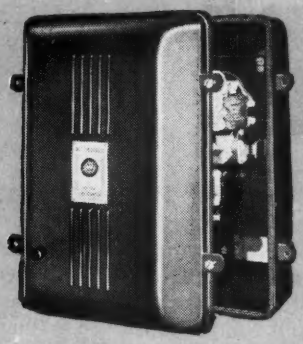
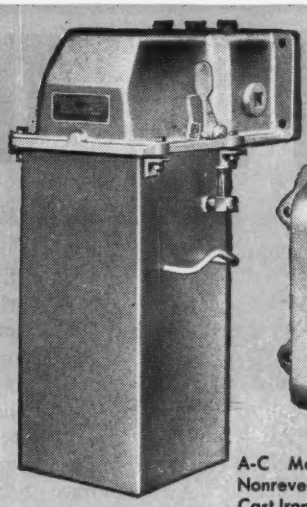
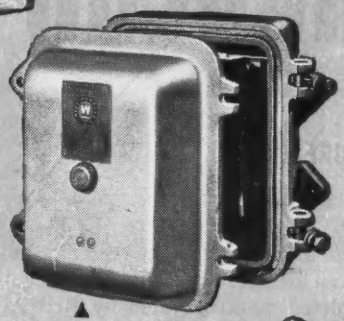
A-C Magnetic "De-ion" Nonreversing Linestarter; Standard Sheet Steel Enclosure.



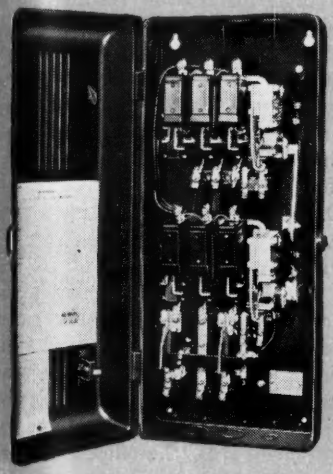
A-C Magnetic "De-ion" Nonreversing Linestarter; Gasketed Dust-Tight Sheet Steel Enclosure.



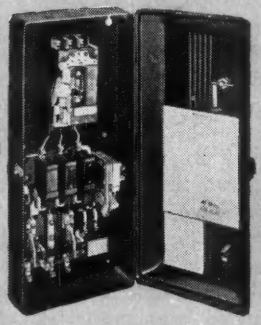
Oil-Immersed "De-ion" Linestarter for Squirrel-Cage Motors for Class I, Group D Hazardous Locations.



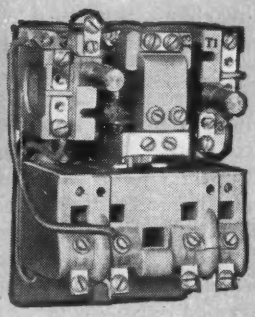
A-C Magnetic "De-ion" Nonreversing Linestarter; Cast Iron with Ground Surfaces between Cover and Case—for Class II, Groups E, F and G Hazardous Locations.



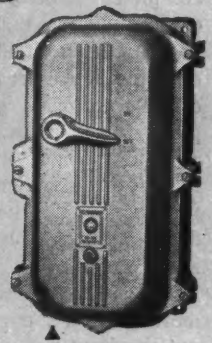
A-C Magnetic "De-ion" Reversing Linestarter for Squirrel-Cage Induction Motors; Standard Sheet Steel Enclosure.



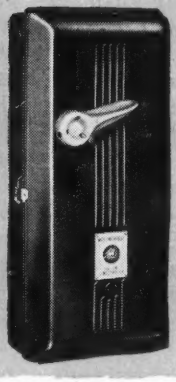
A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Non-Fusible Motor Circuit Switch; Standard Sheet Steel Enclosure.



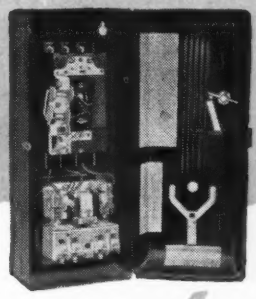
A-C Magnetic "De-ion" Nonreversing Linestarter; Without Enclosure, for Built-in Applications.



A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Non-Fusible Motor Circuit Switch; Water and Dust-Tight Cast-Iron Enclosure.



A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Fusible Motor Circuit Switch; Standard Sheet Steel Enclosure.



A-C Magnetic "De-ion" Combination Nonreversing Linestarter with AB Nofuze Circuit Breaker; Standard Sheet Steel Enclosure.

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MODERN LIGHTING

FLUORESCENTS LIGHT BIG BOMBER PLANT

One of the world's largest and most modern bomber factories, the recently completed plant operated by Bell Aircraft at Marietta, Georgia, 15 miles north of Atlanta, houses an outstanding example of the art and science of modern illuminating engineering. Completely blacked-out, and containing not a single skylight or window, the entire factory is dependent on artificial light for illuminating the machines, benches, desks and assembly-lines of the thousands of employees.

According to the contractors and manufacturer's engineers who worked out the immense installation, the problem they confronted in their plans was two-fold. They were not only faced with the task of furnishing excellent light—50 foot-candles at floor level—for the highly important work of building bombers, but they had to cope with a tremendous temperature problem created by thousands of light bulbs in continuous operation.

Fluorescent lights, 36,000 five-foot, 2-lamp, 200-watt fixtures, solved the puzzle. Compared to incandescent lamps, the fluorescent lights give off very little heat, a factor vital for successful plant operation.

So narrow are the tolerances on some of the parts of the bombers being built in this vast plant that a temperature variation of as little as six degrees Fahrenheit would create inaccuracies because of expansion and contraction. Large plane sections of all kinds would become misfits when the slight change in heat affected the expansion characteristics of the parts.

An elaborate refrigeration system governed by 11 master thermostats, which can control the temperature down to a range of one degree, was the number one project to prevent this sabotage by heat. And the huge installation of fluorescent lights, whose heat contribution was virtually insignificant, was another factor in overcoming the problem.

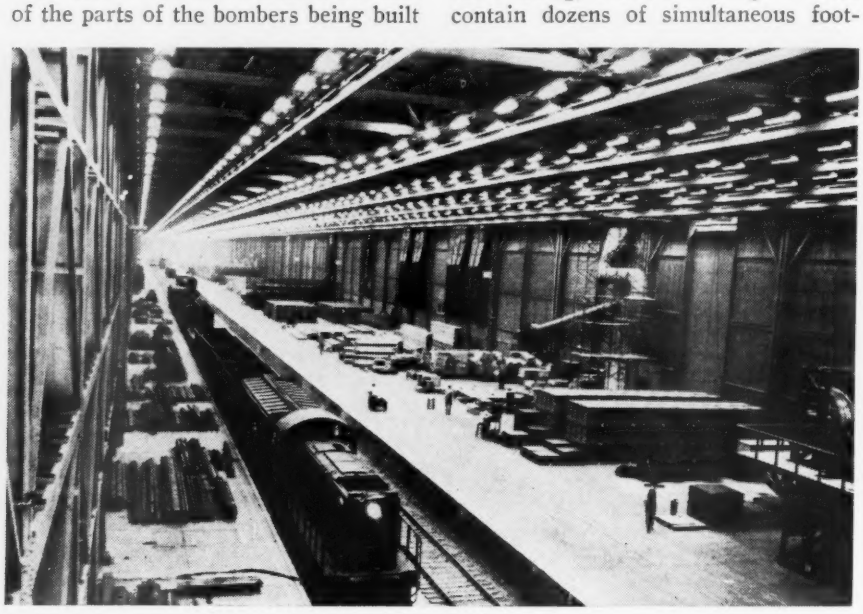
High-bay fluorescent lighting was used throughout, and more than 39 miles of single catwalks have been suspended from crane beams to facilitate reaching the fixtures for washing and servicing. Simplified fixtures were supplied for the Bell installation requiring only the removal of two small hand screws for dismantling and servicing.

The fluorescent fixtures made by Sylvania, were of two-lamp design, five-feet long, and mounted end-to-end. The rows were run in pairs, one row on each side of every crane runway support-beam in the ceiling structure. The double rows run the full length of the building, which is so large it could contain dozens of simultaneous football games. The rows are spaced on 20-foot centers across the width of the structure.

On the main floor where the most precise machines are used and where the most accurate work is required, the problem was to give both general lighting and individual machine lighting. The final installation resulted in one which provided several hundred foot-candles on critical working planes by individual machine lights; and this was supplemented by a system of overhead fluorescent general illumination providing a required minimum intensity of 50 foot-candles at the working level.

One measure of the vastness of this installation is the maintenance. Although the lamps operate for 24 hours per day and have been found to have an average life of about six months, nevertheless, a crew of seven men is assigned to service the lighting units, cleaning, checking and replacing where necessary. So remote are some parts of the plant from the office of Superintendent Walther P. Shelton, who is in charge of electrical and mechanical maintenance, there are eight telephones spaced along the 39 miles of catwalks for him to give instructions to the seven men.

Guarantees against a lighting outage of the plant have been set up. For example, an auxiliary power supply automatically cuts in for emergency lighting, in the event of failure of the standard power source. Changeover occurs without any dark interval in case of an interruption of the current.



***FLUORESCENT LIGHTING** units flood this rail bay loading dock. Supplies must be received and inspected here before being moved into the Bell Aircraft bomber plant at Marietta, Ga.*

LIGHT CONDITIONING IN A SOUTHERN CHURCH

When the new Baptist Temple was built in San Antonio, Texas, the building committee had in mind the complete comfort of the parishoners. Consequently the architects were instructed to include in their specifications a complete air conditioning and light conditioning system—a lighting layout that was functional and not purely artistic in nature. The net result is that the congregation now worships under an illumination intensity that is well above the average for church lighting.

The lighting system, designed under the direction of Floyd A. Covington,

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Single unit, for two or three 40-watt or two 100-watt lamps. Bulletin F-77.

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Continuous runs, for two or three 40-watt or two 100-watt lamps. Bulletin F-77.

DAY-LINE "W" and "WS" Series with "Snap-on" Reflectors

The "W" Series — non-metallic reflectors with Day-Brite's exclusive "Super-White" enamel . . . The "WS" Series — porcelain enamel reflectors . . . Both types available for single-unit installation in two 40-watt, three 40-watt and two 100-watt models . . . Bulletin F-76.

GET FULL INFORMATION

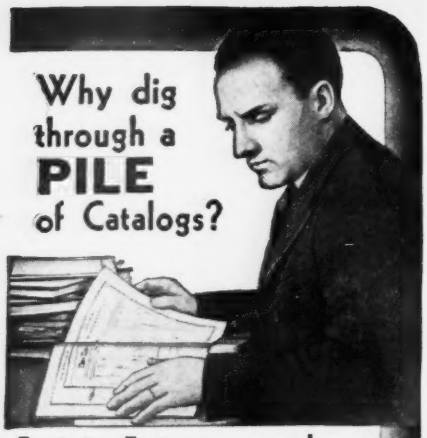
Contact your local Day-Brite engineering representative or write for the Bulletins which contain complete, valuable information fully describing and illustrating both continuous and unit mounting Day-Line Fixtures—including dimensions, mounting diagrams, photometric data, weights and prices.

DAY-BRITE LIGHTING, INCORPORATED
5432 Bulwer Avenue — St. Louis 7, Missouri

Day Brite LIGHTING FIXTURES

DAY-BRITE
The Sign of Quality
Look for this Label

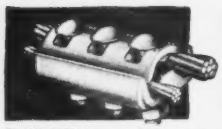
Nationally distributed through all leading electrical supply houses



Why dig through a **PILE** of Catalogs?

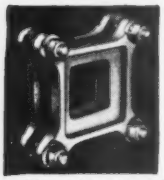
Find the Fitting you need—quickly—in the COMPLETE line

If you have a Penn-Union Catalog, you can instantly find practically every good type of conductor fitting. These few can only suggest the variety:

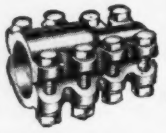


Universal Clamps to take a large range of conductor sizes; with 1, 2, 3, 4 or more bolts.

L-M Elbows, with compression units giving a dependable grip on both conductors. Also Straight Connectors and Tees with same contact units.



Bus Bar Clamps for installation without drilling bus. Single and multiple. Also bus supports — various types.



Clamp Type Straight Connectors and Reducers, Elbows, Tees, Terminals, Stud Connectors, etc.

Jack-Knife connectors for simple and easy disconnection of motor leads, etc. Spring action — self locking.

Vi-Tite Terminals for quick installation and easy taping. Also sleeve type terminals, screw type, shrink fit, etc. etc.

Splicing Sleeves, Figure 8 and Oval, seamless tubing—also split tinned sleeves. High conductivity copper; close dimensions.

Preferred by utilities, industrials, electrical manufacturers, contractors — because *they have found that "Penn-Union" on a fitting is their best guarantee of Dependability.*

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

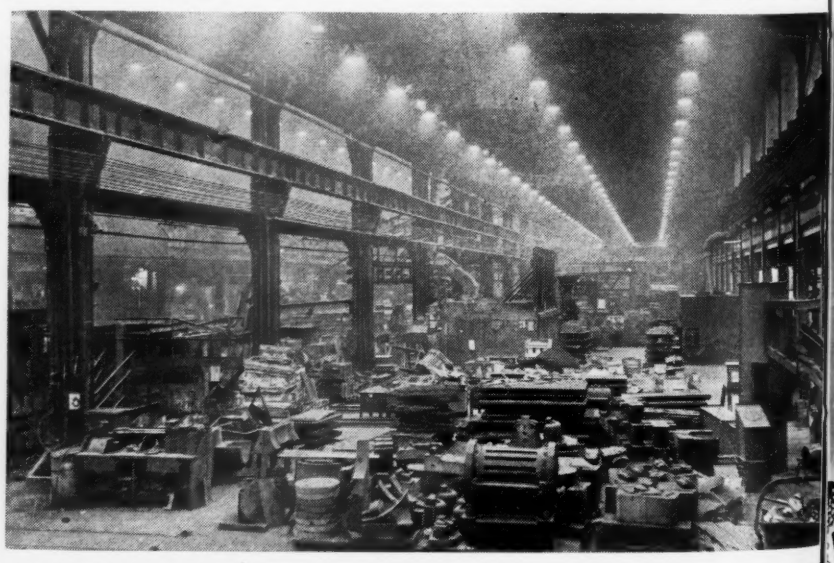
PENN-UNION
Conductor Fittings

***LIGHT CONDITIONING** adds to the physical comfort of parishioners in this air-conditioned San Antonio church where an average of better than 15 foot-candles of incandescent lighting is provided at reading level.*

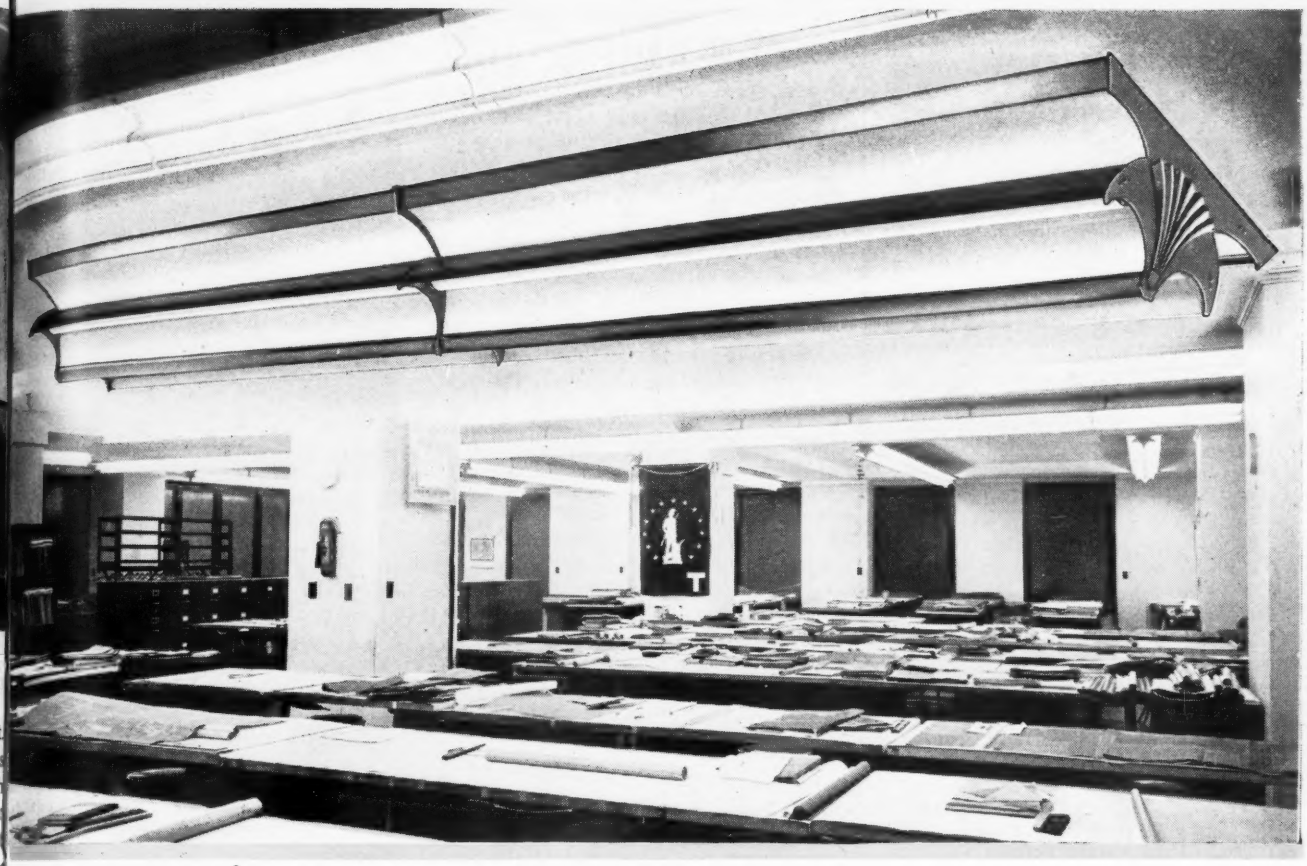
lighting engineer for the City Public Service Board of San Antonio and installed by the F. A. Menger Electric Company of the same city, blends well with the simple architecture of the structure. Incandescent units composed of Hub enclosures with Holophane controlens are used predominently in the church auditorium which is approximately 71 feet wide and 94 feet long (seven 13½-ft. bays, including two in the balcony section).

The design consists of four rows of units—one unit per bay in each row—running parallel to the length of the auditorium. Mounted semi-flush in the ceiling (to help dissipate some of the heat into the hung ceiling) and running down the center of the auditorium is a double row of two-lamp units, 3-ft between rows. Each fixture contai two, 300-watt, clear lamps. On each side of the auditorium and 13 feet ou from the wall is a row of 300-wat single lamp units. A total of 13 single-lamp 200-watt fixtures are mounte in a similar pattern over the balcony which has a small offset between th entrance stairwells. Under the balcony because of the low ceiling height, seven two-lamp, 40-watt fluorescent units ar installed flush with the ceiling o asymmetrical spacing.

When light-meter readings wer taken at seat reading levels, the inten sities ranged from 10 foot-candles a the walls to 25 foot-candles at th center of the auditorium.



***FOUNDRY LIGHTING** is difficult both from a design and maintenance standpoint. This installation at the Westinghouse foundry in Trafford, Pa. provides 15 foot-candles of maintained illumination at working level. High bay luminaires use 750-watt bulbs. Fixtures are spaced on 16-foot centers both ways at a height of 35 feet.*



The Curtis SKYLUX

for Two 40-Watt Fluorescent Lamps

Here is the most outstanding two-lamp fixture on the market! Check over these features . . . First, SkyLux is scientifically shielded to prevent a direct view of the lamp from ordinary angles . . . next, the baked snow-white Fluracite reflecting surfaces direct the light downward without trapping any of the output of the lamp . . . Then, because there are no horizontal surfaces to collect dust, SkyLux is easily maintained at peak efficiency throughout the life of the unit . . . These features, plus the fact that SkyLux can be ceiling or pendant mounted individually, as well as in continuous lines, make it the logical choice for office lighting installations.

CURTIS Lighting, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

When You Buy a
BENDER
... Check to Make Sure You Get These Features

EASY TO GET TO THE JOB
Lightweight and portable, one man can easily carry or roll any Blackhawk Pipe Bender right to the job. Saves time and manpower. Bend rigid conduit and pipe up to 4".

WORK AT ALL ANGLES
Compact hydraulic Porto-Power ram of Blackhawk Pipe Bender works in all directions. Unique design. Avoids kinking. Power eliminates need for heating.

WORK OVERHEAD
All-directional operation and light weight permits work on existing pipe runs.

SIGHT FROM ANY ANGLE
Remote control permits operator to stand in any position necessary to give him full view of job. Blackhawk Benders save need for elbows and couplings and otherwise necessary cutting and threading.

DETACHABLE POWER UNIT *for Extra Utility*
This unit (the heart of the bender) with special available Porto-Power attachments, can be adapted for pulling drive pulleys, lifting heavy equipment into place and doing scores of other trouble jobs.

BLACKHAWK MFG. COMPANY
Dept. P2064, Milwaukee, Wis.
Send full information on your pipe benders.
Name.....
Company.....
Address.....
City..... State.....

BLACKHAWK
Porto-Power
PIPE BENDERS

EGGS ARE INSPECTED UNDER CANOPY OF FLUORESCENT LIGHT

Hundreds of thousands of eggs are inspected, broken and separated daily in the Egg Drying Plant of the Joe Lowe Corp., San Antonio, Texas. Good seeing conditions are a must in this industry whose production now goes 100 percent to the filling of government orders. If bad eggs get by they can contaminate whole batches and seriously reduce production.

When the plant management realized its six to eight foot-candle lighting intensity was inadequate and that something had to be done about the lighting system, it consulted the lighting department of the City Public Service Board of San Antonio. Lighting engineer Floyd A. Covington recommended and designed a fluorescent lighting layout that provides an average illumination intensity of 32 foot-candle on the working plane in the egg-breaking room shown in the accompanying photograph. With walls and ceilings painted a light color, the lighting efficiency is enhanced.

Installed by Loyd Electric Company of San Antonio, the system consists of 18 RLM type fluorescent units, each containing two 40-watt daylight fluorescent lamps. The units are mounted directly over the center of the three rows of tables at which approximately 130 girls work inspecting, opening and separating the eggs which later go through the drying process. Six fixtures on 10-ft. centers are rod suspended over each row of benches and fed by conduit circuits. Daylight lamps were chosen because they provide the best quality of light for the work being done. Under the new lighting system each girl inspects, breaks and separates approximately 4000 eggs per day with assurance that the job is well done.

MORE LIGHT is provided by newly installed fluorescent units. W. N. Attaway (right foreground), Houston Lighting and Power Co., explains the operation to Mr. Wolf, owner of the Wolf Pattern Works.

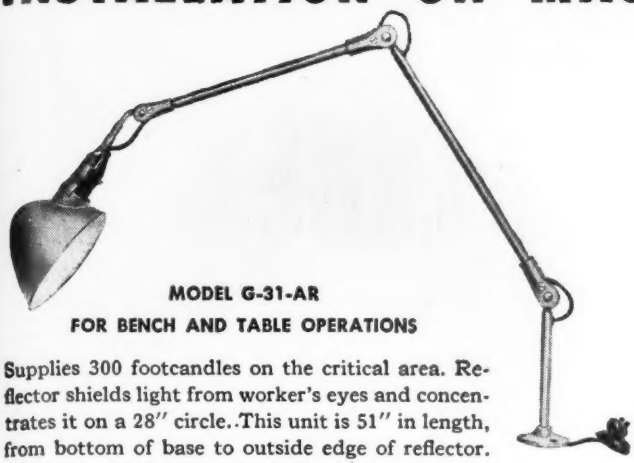
PATTERN WORKS CHANGES TO FLUORESCENT

Forsaking the old 200-watt, fixtures Wolf Pattern Works, Houston, Texas modernized its shop lighting wit fluorescent units. Now the patter makers work under 30 to 35 foot-candles of cool, evenly distributed illumination—more than double the averag intensity of the original lighting.

The new layout, designed by W. N Attaway, commercial and industria engineer, Houston Lighting and Powe Company, consists of a twin-lamp 40-watt, industrial type fluorescent uni over each bench. Approximate spacing between the fixtures, which ar chain suspended from the ceiling, is 1 feet with an 8-ft., 6-in., mounting height. Units are individually controlled by pull chain switches.

***G. I. EGGS SEE THE LIGHT** of daylight fluorescent lamps as they are inspected, opened and separated in this egg-breaking room before going through the drying process in this San Antonio egg drying plant.*

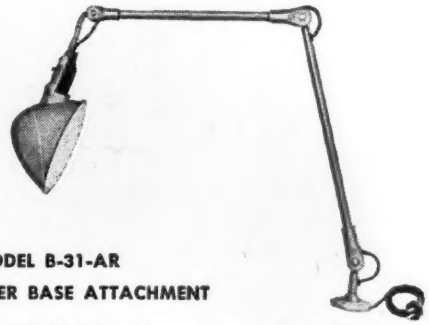
6 WESTINGHOUSE FOCALAIRES...FOR INSTALLATION ON MACHINES, BENCHES, TABLES



MODEL G-31-AR

FOR BENCH AND TABLE OPERATIONS

Supplies 300 footcandles on the critical area. Reflector shields light from worker's eyes and concentrates it on a 28" circle. This unit is 51" in length, from bottom of base to outside edge of reflector. Base 8", arms 11½" and 16½", reflector assembly 12" long.



MODEL B-31-AR

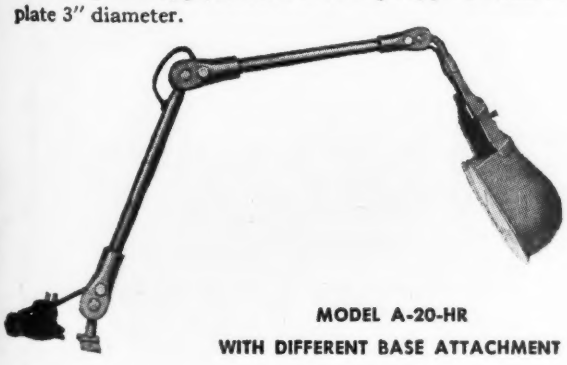
WITH SHORTER BASE ATTACHMENT

Identical with Model G-31-AR above, except that the base is only 5⅛" high, making the over-all length 48⅛". Ball-clip joints permit quick, easy adjustment.

MODEL B-20-HR

FOR LIGHTING SMALL-MACHINE AREAS

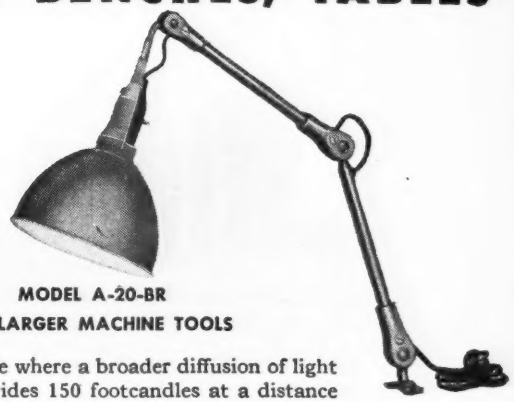
Provides more than 200 footcandles 12 inches from the reflector, on a work area 20" by 16". Over-all length is 35⅝", base 5⅛", arms 10½" and 9½", reflector assembly 10½". Circular mounting plate 3" diameter.



MODEL A-20-HR

WITH DIFFERENT BASE ATTACHMENT

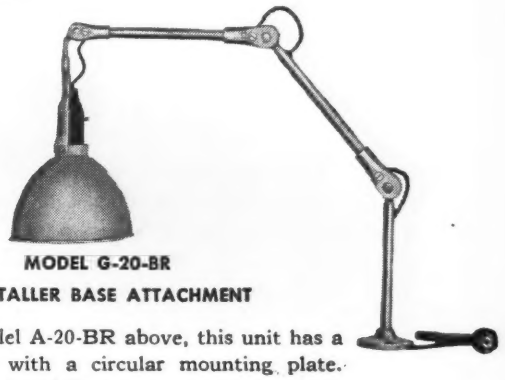
This unit is the same as Model B-20-HR except that it has a short 1¾" base and narrow type of mounting bracket.



MODEL A-20-BR

FOR LARGER MACHINE TOOLS

Designed for use where a broader diffusion of light is desired. Provides 150 footcandles at a distance of 12 inches from the reflector. Over-all length is 32", base 1¾" high, arms 10½" and 9½", reflector assembly 10¼". Bracket-type base can be mounted in a space 3" by 1"



MODEL G-20-BR

WITH TALLER BASE ATTACHMENT

Similar to Model A-20-BR above, this unit has a base 8" high, with a circular mounting plate. Over-all length is 38¼".

IMPORTANT FEATURES OF THE WESTINGHOUSE FOCALAIRE

1. Quickly adjusted by simple ball and socket joints.
2. Shake-proof—resists vibration of machine.
3. All parts are welded for strength.
4. Wire is run inside of tubular arms and has oil-resistant insulation.
5. Reflector is spot-welded to socket guard.
6. Furnished in 6 standard types, with regular machine tool gray finish.
7. Special sizes can be made up from standard part of arms, reflectors and bases.

Westinghouse

FOCALAIRE

Answered by
F. N. M. SQUIRES
Chief Inspector New York Board of Fire Underwriters

QUESTIONS ON THE CODE

BONDING JUMPERS IN HAZARDOUS LOCATIONS

Q. *"In hazardous locations, class 1, (Section 5025), it is stated that 'the locknut-bushing and the double-locknut types of contact shall not be depended on for bonding purposes, but bonding jumpers with proper fittings or other approved means shall be used'.*

"How can this statement be reconciled with Section 5014 which specifically calls for explosion-proof fittings in such locations?"—J.O.D.

A. Locknuts and bushings will not generally be required within the hazardous area because boxes within such an area must have threaded hubs. The threaded hubs satisfactorily take care of the grounding bond.

Where equipment in a hazardous location is supplied through a conduit run from a non-hazardous area treatment as specified in Section 5025 is required. This rule then requires that (at panel cabinets, splices, pull or junction boxes in the conduit, bonding jumpers must be used), when such boxes do not have the threaded hubs.

The use of these bonding jumpers is required all the way back to the service equipment regardless of how many boxes or cabinets the circuit or feeder may pass through, even in the non-hazardous area.

This is one requirement which is very often overlooked.

SPRAY BOOTH LIGHTING

Q. *"I would like very much to have an answer to the following article.*

"In a spray booth where there is a circulating pump system for water fumes and spray out, is it permissible to place explosion-proof lights inside the booth as designed? Places are provided for four to six lights according to the size of the booth.

Paragraph 5204 in Article 500 states that all lighting fixtures must be at least 10 feet from the spray booth working face.

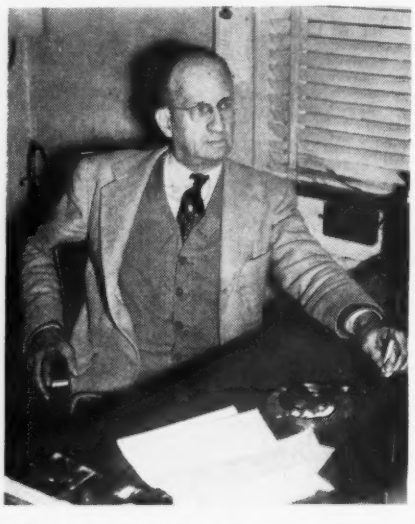
"Has this type of booth come out since the Code was printed and only applies to booth without water?

"Have been informed by the inspector that the lights must be placed outside."—A.J.H.S.

A. The National Electrical Code is very plain on this matter and as indicated above states that no lamps or lighting fixtures of any type can be located within a spray booth. The 10 foot reference in the second sentence of section 5024 is in regard to the auxiliaries of mercury vapor lamps. However, this reference to a measurement of 10 feet has lead inspection bureaus to consider that any fixture or other electrical device within 10 feet of the open front of a spray booth is in a hazardous area and therefore must be of the explosion-proof type.

While it is true that the rule was written before the wide use of the new water bath spray booths, still the water bath will not extract the explosive fumes from the exhaust and of course will not reduce the concentration of explosive mixture in the booth proper and therefore the fact that the booth is fitted with the water bath would not make it permissible to disregard the strict rule that there must be no fixture in the booth.

Spray booths, therefore, can receive their illumination only from the outside. One method is to place lighting fixtures such as floodlights or spotlights back of the open front of the booth, in which case the inspection bureaus may, and probably will, require (1) explosion-proof fixtures if they are within 10 feet of the booth or (2) a fixture located outside of the top or side of the booth behind a plate of wired glass which is fitted into an opening in the wall of the booth with gaskets.



NAVY TRAINED *Wm. M. Payne, Payne Electric Works, Houston, Texas, used his electrical background to serve Houston industrials and shipyards for the past 23 years. After finishing Navy Electrical School in 1910, he spent nine years in the service—the last three as warrant officer of the electrical dept. on a battleship, cruiser and submarine. During his hitch he recalls visiting practically every seaport in China.*

MOTOR DISCONNECT

Q. *"Is there any ruling that all starting equipment must have a fused disconnect ahead of the starting equipment? We have made such installations in the past and there is now a question with plant management whether this is necessary.*

"I have been unable to find a ruling in the 1940 book of National Board of Fire Underwriters to substantiate former installations. Please advise if this is necessary and, if so, where I can find the authority for same."—C.H.

A. Section 4381 of the National Electrical Code (1940 Edition) requires controllers for all motors.

Section 4401 has the intent of requiring disconnecting means for all motors. Under certain conditions the same device may serve as both a controller for a motor and the disconnecting means. This is found in Section 4407.

VICTIMS OF A "MECHANICAL BRAIN"

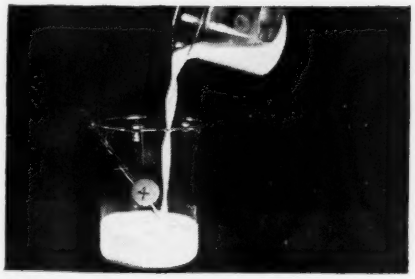
Zeros knocked out of the sky at the rate of one to every 90 rounds of ammunition fired! That's the feat our anti-aircraft batteries are performing in the South Pacific. During World War I, the average was but one plane to every 17,000 rounds.

Credit is due largely to the new M9 gun director—a "mechanical brain" that aims a battery of four 90mm. guns and sets their fuses. Everything is done mathematically by electricity.

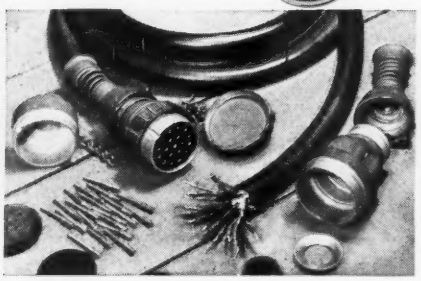
The delicate synchronization of tracker, height finder, computer, power rectifier and altitude converter depends on scientific perfection of the electrical cable.

Laytex Portable Cable, developed by U.S. Rubber Company engineers, is used throughout. It transmits the data for lightning-fast calculation without chance of human error, resulting in fire control of deadly accuracy. Results attest how exactly this cable meets this specialized need.

Laytex REG. U. S. PAT. OFF. **WIRES AND CABLES** **SERVING THROUGH SCIENCE**



PURIFIED LIQUID LATEX is used for Laytex Wire and Cable Insulation. A special process removes moisture and water-soluble impurities. Laytex insulation—whether made from either natural or synthetic rubber—has exceptional dielectric strength.



CABLE AND PLUG ASSEMBLY for the M9 gun director. Laytex Insulation developed by U.S. Rubber Company engineers is built up into a homogeneous unit around the perfectly centered wires by an exclusive process of repeated dipping and drying, followed by vulcanization.

TOMORROW'S PROMISE — Although the entire output is still going to meet critical war needs, a day will inevitably arrive when we shall again supply U. S. Laytex Wires and Cables for Buildings, Police and Fire Alarms, Communications, Signalling, Power and Control.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

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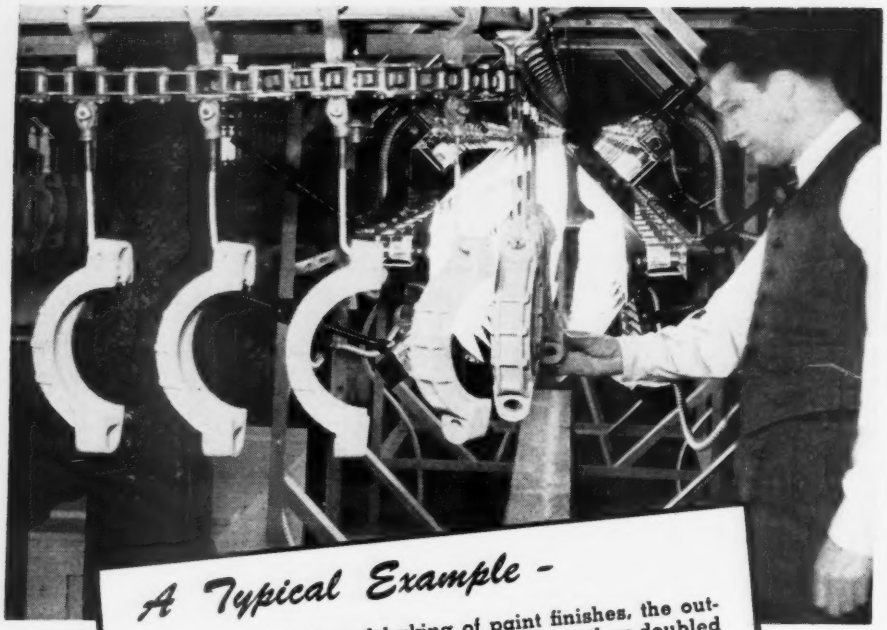
AN INDUSTRIAL TOOL OF GREAT EFFICIENCY for Baking • Drying • Dehydrating and Preheating Operations



A Typical Example -

By the speedy Infrared baking of paint finishes, the output of oil pipeline couplings has been more than doubled at Lake City Malleable Co., Cleveland. In this typical example of greatly increased production efficiency obtained by utilization of Infrared, the pipeline couplings move on a continuous conveyor through the paint tank, Infrared drying tunnel, to packing in shipping containers. Savings in handling, space and energy add to the advantage of production speed.

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FOR BAKING • DRYING • PREHEATING • DEHYDRATING

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This section (4407) states that if a switch or circuit breaker complies with the requirements (of section 4383) as to rating, it may serve both as the controller and the disconnecting means if the device opens all of the ungrounded wires to the motor (which ordinarily a controller does not have to do) and providing it is protected by an overcurrent device and further provided the device is either:—

a. An air break switch, operable directly by applying the hand to a lever or handle, or
b. A circuit breaker, similarly operated, or
c. An oil switch

It will be noted that a magnetic controller is not included in the above and that therefore a disconnecting means is required ahead of a magnetic starter.

The thoughts behind the requirements are that there must be some positive means of interrupting all of the current to a motor in an emergency. And also that there must be some way of disconnecting a motor controller, not of one of the three types mentioned above, from all sources of current to allow repair and maintenance of both the motor and the controller.

ELECTRIC RANGES

Q. *"Is it necessary to wire permanently to an electric range, or can a range be connected by means of a flexible cord?"*—V.H.

A. The use of flexible cord is restricted to pendant drops, wiring of fixtures, elevator cables, *connection of portable appliances* or to the connection of stationary devices (or appliances), to facilitate their interchange or to prevent transmission of noise or vibrations.

With electric ranges the factors involved are portability and interchange. Many electric ranges are of such size that they cannot be considered as portable and most of these are never shifted from the place in which they are originally set.

However, one condition not mentioned in the Code, might make permanent connection undesirable. For instance, a tenant renting premises might be compelled to leave his range when he moved if he made it a permanently connected fixture. In a case of this kind, undoubtedly the authority would permit a portable connection.

On the other hand a small range, even though it may seldom be moved, even for cleaning, would come under the portable class, and therefore could be connected by means of a cord.

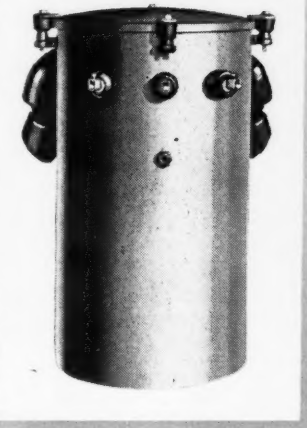
Standard

TRADE MARK

DISTRIBUTION TRANSFORMERS

Engineered and Built to your Requirements

Illustrating two popular types of STANDARD Distribution Transformers; (*right*) 250 KVA Liquid Cooled, 2400 volt unit; (*below*) type A, 15 KVA, 2400—120/240 volt transformer. Standard Distribution Transfocmers are built in capacities from 1.5 to 500 KVA, all commercial voltages, frequencies, etc.



Serving industrial plants, municipalities, mines and utilities everywhere, Standard Transformers are engineered and built to fulfill the special requirements of each particular job. Shown above are two types of Distribution transformers—and at the right are representative units from several other classifications of our complete line. Standard Transformers are made in capacities up to 10,000 KVA self-cooled and voltages up to 69,000 inclusive.

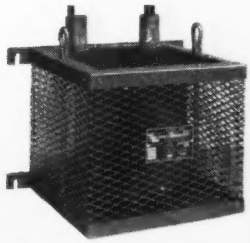
Write for complete information on the many advanced engineering and construction features that make STANDARD Transformers economical and dependable in service.

STANDARD

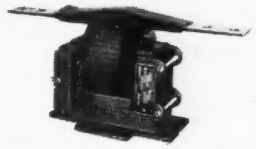
TRANSFORMER COMPANY WARREN, OHIO

Representatives in Principal Cities

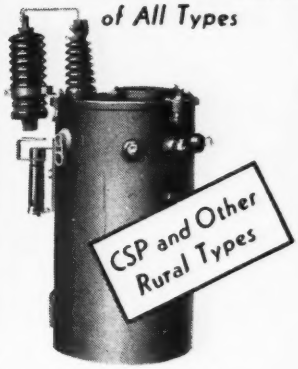
Other STANDARD TRANSFORMERS



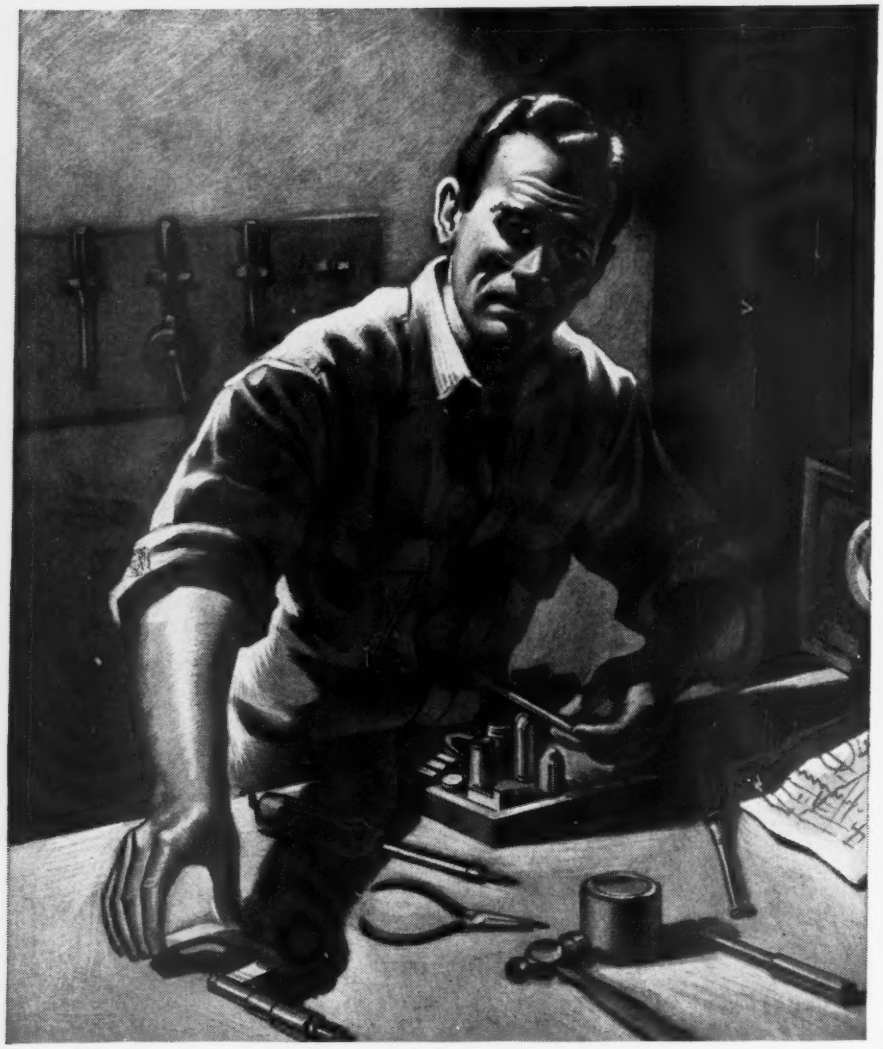
Dry Type . . . Indoor



Instrument Transformers of All Types



Power Transformers up to 10,000 kva



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Engineered Relighting

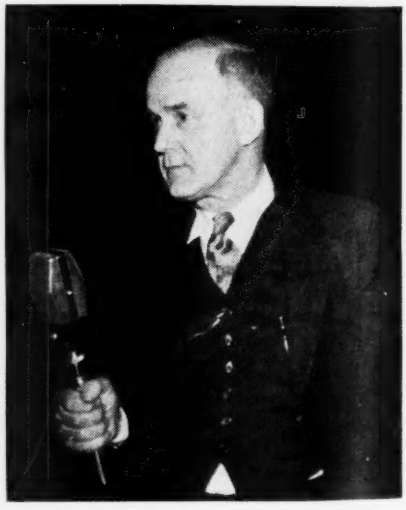
[FROM PAGE 61]

a 12-inch spacing between ends of reflectors, these two-lamp, 40-watt, daylight fixtures provide an intensity varying from 140 foot-candles at the center to better than 80 foot-candles at the edge of the tables. The lighting engineer's recommendations for the addition of general lighting to reduce contrast are being followed.

The tool making department was the last area to be relighted. Here again, continuous rows of Day-Brite, RLM fluorescent units were installed. Three rows of two-lamp, 40-watt daylight fixtures spaced on 7-foot centers, nine feet above the floor, provide 75 to 80 foot-candles of illumination on the working plane (after 100 hours of operation) in this 840 sq. ft. area. Each row of 12 units is controlled by four pull switches. Local lighting units on machines have been disconnected.

This case history presents a real challenge to plants now working under the handicap of inadequate lighting facilities. Here production goes rolling along night and day under lighting that fits the job at hand. Eye fatigue and headaches are no longer a hazard to employee health. And management is reaping dividends in increased quantity and quality of production and higher employee morale—important assets to the war effort.

Full credit for licking the inadequate lighting bottleneck in this plant goes to the understanding and cooperative efforts of the plant superintendent, management, lighting engineer and electrical contractor.



THE ANSWER to a perplexing electrical maintenance problem is given by H. T. Fox, chief electrician . . . S. Rubber Company's Indianapolis plant, at the maintenance panel of the recent Indianapolis War Production Clinic.

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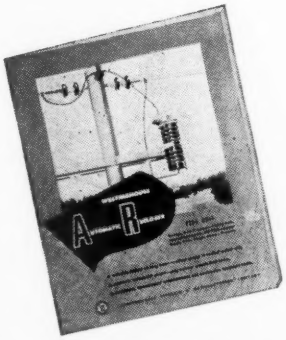
This bulletin—B-3329—presents complete application data on the new AR-1 Reclosers. It describes how to co-ordinate them with other protective devices, gives features, dimensions, methods of mounting and ordering information. Ask your nearest Westinghouse distributor for a copy today. Or, write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.



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On temporary faults, the AR-1 Recloser *opens, recloses* and *resets itself.* It is then ready for operation over the same cycle. If the line fails to clear, the recloser attempts to re-energize the line three times and then locks out. Ample time delay on tripping permits co-ordination with other reclosers and standard fuses to reduce line outages to an absolute minimum.

The AR-1 Reclosers eliminate inspection and service trips on transient faults, avoid revenue loss on unnecessarily dead lines, improve suburban rural line service, build customer good will. Ask your Westinghouse distributor about them today. J-90510

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PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

The Cathode Ray Oscilloscope —What It Is, How To Use It

For the man who must install and maintain electronic equipment, the cathode ray oscilloscope is his most important tool.

By O. W. Livingston
Electronic Section
Industrial Control Engineering Div.
General Electric Company

THE cathode ray oscilloscope should be to the service man and engineer what the x-ray is to the doctor. It is a quick, convenient way of checking conditions that cannot be checked by any other direct means. In a few seconds, one is able to actually "see" the voltage across a given part of a circuit, which may permit very rapid diagnosis of a faulty condition.

The purpose of this article is to explain the fundamentals of the use of this instrument for the installation, and maintenance of industrial electronic equipment.

Most commercially available cathode ray oscilloscopes consist of a rectangular metal case which contains the cathode ray tube, power supplies, timing circuit and amplifiers. The screen end of the cathode ray tube is generally visible from one end of the enclosure, on which are mounted the various control knobs and switches. Figure 1 shows a sketch of the operating end of a typical oscilloscope. While different models vary in size and arrangement of the controls, the controls generally perform similar functions and are generally carefully labeled.

In operation, a beam of electrons generated inside the cathode ray tube is focused on the fluorescent screen of the tube which then produces a tiny spot of light where the beam strikes. This beam is then bent or deflected by applying voltage to two sets of electrostatic deflection plates so that the spot of light on the screen moves, or "writes" producing a pattern on the screen determined by the voltages applied to the deflection plates. In most instances, a definite "timing" voltage is applied to the horizontal plates so that the beam is swept from left to right uniformly in a definite period of time such as 1/60 second and then returned almost instantly to the left side to repeat indefinitely. If at the same time a voltage is applied to the vertical deflecting plates which is of periodic nature with a frequency of say 60 cycles, a stationary trace appears on the screen which permits the observer to immediately determine the instantaneous variations of voltage during the cycle. Due to the ease and speed that the beam of electrons can be deflected, it is possible to record very rapid variations of voltage that magnet type oscilloscopes could not follow.

Choice of a Suitable Oscilloscope

Commercial equipments have been built using 1-in., 2-in., 3-in., 5-in., and even larger screen diameter tubes. The equipments having the larger size tubes

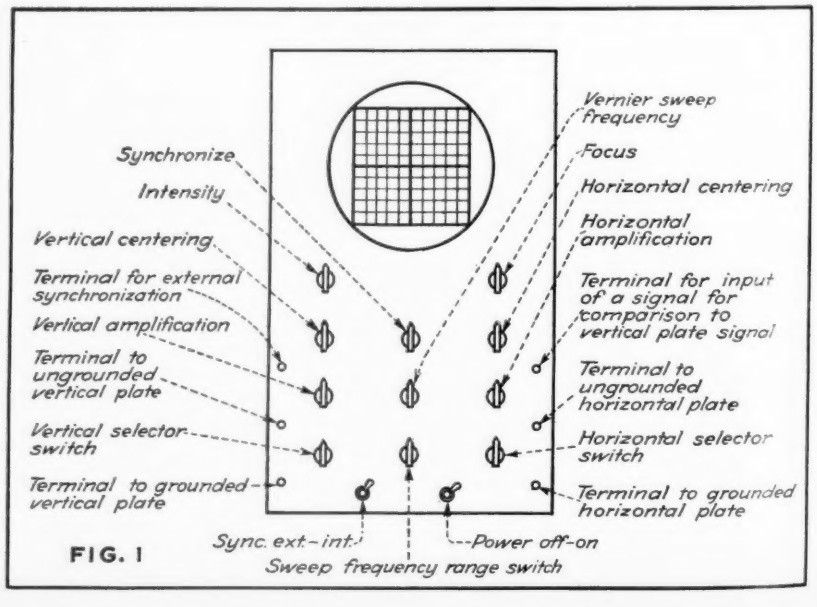
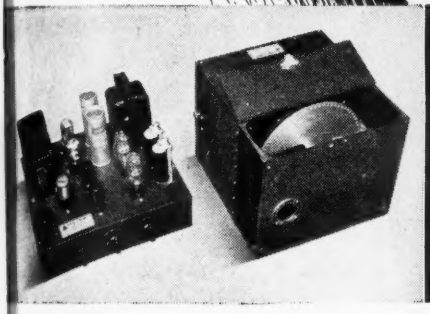
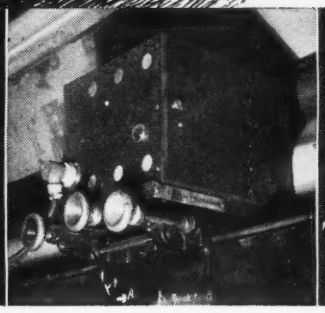


FIG. 1

HOW AN RCA ELECTRON TUBE SAVES PAPER



Scanner and Amplifier convert light reflections into faint electric impulses and amplify them to control position of paper during color printing. Equipment developed by Research Laboratories of ALCO GRAVURE and produced by Morrill & Morrill.



Scanner head mounted at the press rollers. Its "magic brain" consists of 12 RCA Electron tubes: a 929, 6J7, four 6SJ7's, a 6H6, 6SN7-GT, two 2050's, a 5Y3-GT, and a 6X5.

COLOR printing that's "out of register" has caused many a reader to frown...many a publisher and printer to reach for the aspirin.

The picture of the War Bond poster shown above was purposely printed improperly ... to illustrate what printers call "out of register." The term means that the impressions of two or more printing plates do not fit together as they should.

It takes patience and great skill to adjust color presses accurately *by hand*. And a considerable amount of paper is usually wasted in the process, because the adjustments must be made while the presses are running.

ALCO GRAVURE, of Hoboken, N. J., has solved this problem ... by electronics.

While the first color is run off, positioning dots are simultaneously printed on the edge of the paper. As the paper is fed through the rollers for each subsequent color application, a sensitive RCA phototube scans the edges of the paper, picks up the light variation reflected by the dots, and instantly converts these reflections into tiny electric impulses. These are immediately amplified by another set of RCA tubes, and used to control the position of the paper with respect to the rollers.

This electronic device, first installed by ALCO GRAVURE several years ago, resulted in far more precise color registry than was formerly possible by hand...and has saved many tons of paper per press per year.

RCA electron tubes are destined to play an increasingly important part in industry...for measurement, counting, weighing, control, high-frequency heating, and an almost limitless variety of other purposes. If you believe that electronics can do some job better, faster, more accurately, or cheaper than is being done in your plant today, and will write to us about your specific problem, we will gladly refer you to the equipment manufacturer best fitted to serve you. Or our own engineers may be able to help. *For the Magic Brain of all electronic equipment is a Tube ... and the fountain-head of modern Tube development is RCA.*

Meantime, may we mail you our 32-page, color-illustrated, free booklet "*Electrons in Action at RCA*"? Simply write RCA, Commercial Engineering Section, 617 South 5th St., Harrison, N. J.

RCA

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obviously give a larger easier to read picture. On the other hand they are larger, heavier, and generally more expensive. Where portability is not necessary a 5-in. size might well be most desirable, but if the equipment must be carried around frequently the 3-in. or 2-in. will probably be most satisfactory and even the 1-in. is capable of giving very satisfactory results where extreme portability is necessary.

Practically all of the oscilloscopes now on the market that have come to our attention require some modification to make them suitable for industrial use. At least one and generally more modifications must be made. Before purchasing an oscilloscope, obtain an instruction book with the circuit diagram, and make sure that the modifications described on this page can be made without excessive rebuilding.

1. D.C. deflection
2. Sweep synchronization
3. Input circuit

Technique in Using the Oscilloscope

So that effective use can be made of an oscilloscope, it is necessary: (1) to have a dependable instrument modified as outlined; (2) to be thoroughly familiar with the particular oscilloscope to be used; and (3) to become familiar with the wave-shapes of the apparatus to be installed or maintained when this apparatus is functioning properly.

After reading the manufacturer's instruction book, one unfamiliar with oscilloscopes should first familiarize himself with such simple adjustments as beam intensity, focus, and sweep frequency. After a good sharp beam has been obtained and the sweep circuit is causing the spot to move across the screen so as to produce a straight horizontal line pattern, the deflection may be checked. With the amplifier cut out and with short input leads to insure against pickup, turn the potentiometer for maximum sensitivity and note the position of the zero line on the transparent cross-sectioned screen generally provided in front of the tube screen. In most cases, the modification to permit reading d.c. requires the removal of the vertical centering circuit. Thus it will be necessary either to note the position of the true zero to the scale zero or, if it is possible, to move the transparent screen up or down until its zero coincides with the true zero.

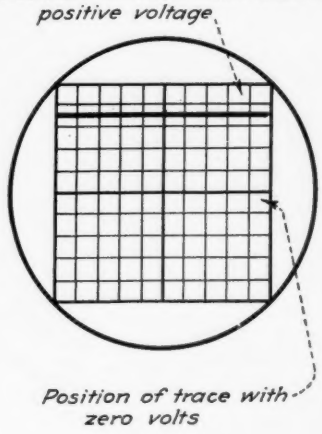


FIG. 2

Next a source of d.c., such as a 45-volt B battery, should be connected to the input terminals with the positive lead connected to the ungrounded side. If the oscilloscope has been properly modified to read d.c. the horizontal trace should be displaced vertically upwards as shown in Figure 2 and should remain in that position as long as the battery voltage is applied. If the instrument has not been properly modified it may deflect momentarily and then return to zero indicating it cannot read d.c. at all, or it may deflect downward indicating reversed sense. Either condition should be corrected as soon as possible.

At this time it is possible to determine the deflection sensitivity in terms of volts-per-inch or volts-per-screen-division at full sensitivity. This sensitivity will vary depending on the type of tube used and the anode voltage; higher anode voltages producing brighter patterns but lower deflection sensitivities. Sensitivities ranging from 70 volts per inch to several hundred may be anticipated. It may also be desirable at this time to check the deflection sensitivity at a number of different positions of the sensitivity control potentiometer so that a calibration curve can be made showing volts per division (or inch) against potentiometer setting.

It is suggested that a sine-wave voltage of supply frequency next be applied to the deflecting plates to observe the operation of the sweep and the synchronizing circuits. The best procedure to follow is to turn the synchronizing control to zero and then adjust the sweep range switch and the sweep vernier potentiometer to approximately the right value so that the pattern is almost stationary on the screen. Then, with the proper selector switches thrown to obtain the synchronizing signal from the supply frequency, the

OSCILLOSCOPE MODIFICATION

1. D.C. Deflection

Most of the oscilloscopes now on the market give only a momentary deflection when a d.c. voltage is applied to the input terminals. This characteristic, which is objectionable for most industrial uses, can sometimes be overcome by applying the signal directly to the vertical deflecting plates (a suitable external voltage divider must be used if the voltage is too large) where these terminals are available. However it is generally preferable to change the internal connections so that it is not necessary to carry around an additional external voltage divider "haywired" to the oscilloscope. If this modification is properly made it still permits switching in the a.c. amplifier, generally available for very low voltage signals, although under this condition it is not possible to observe d.c. signals.

In making this modification the polarity of the vertical deflection and the direction of the sweep should be corrected if necessary so that when the oscilloscope is conected to read d.c. a positive signal on the ungrounded vertical deflection plate causes the beam to move upwards, and the sweep "writes" from left to right.

2. Sweep Synchronization

Some instruments are designed so that it is difficult or impossible to synchronize the sweep when the amplifier is not used. It is generally possible to correct this by feeding back some of the supply frequency through a suitable on-off or selector switch to the synchronizing transformer generally used in the grid circuit of the sweep circuit thyratron tube.

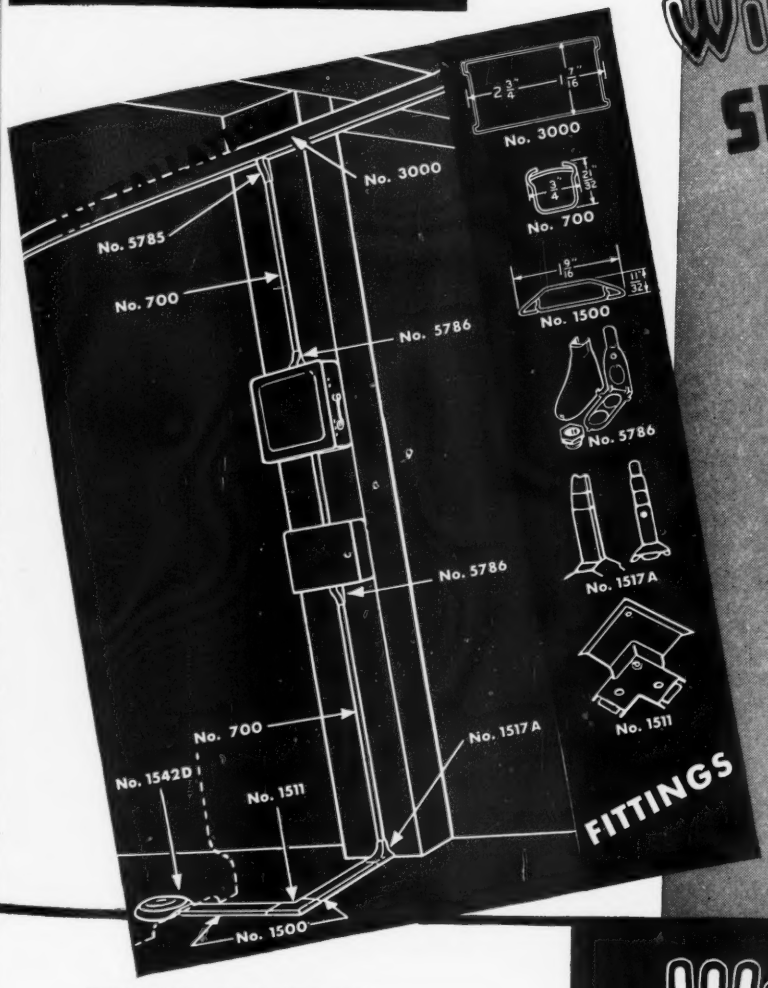
3. Input Circuit

If the instrument is to be used on high power circuits it is generally desirable to modify the input circuits. Terminals with more creepage and wider spacing, preferably mounted on an insulated panel, reduce the danger of short circuit due to carelessly attached leads. A series protective resistor of about 10,000 ohms mounted directly on the ungrounded deflection terminal and backed up with a small fuse minimizes possibility of trouble if the input potentiometer fails. It is also generally desirable to replace the original input potentiometer with one having about 5 megohms resistance to minimize loading of any high impedance circuit being measured. This potentiometer is generally fitted with a switch so that when it is turned for maximum sensitivity the potentiometer circuit is opened, giving a minimum loading effect on the circuit being observed.

the problem

Simplified wiring of small motor-driven machines

the answer



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● Shown in the photograph above and the diagram at the left is the wiring layout for a group of small presses. This clean, efficient, safe installation required no costly channeling of floors and eliminated drop connections from overhead wiring. It demonstrates how Wiremold Raceways interconnect one with another to meet widely varying installation needs. Here No. 3000 is used to carry sub-feeders, with take-off at each station through No. 700 to motor controls, and to No. 1500 Pancake across floor, completing connection to the machines.

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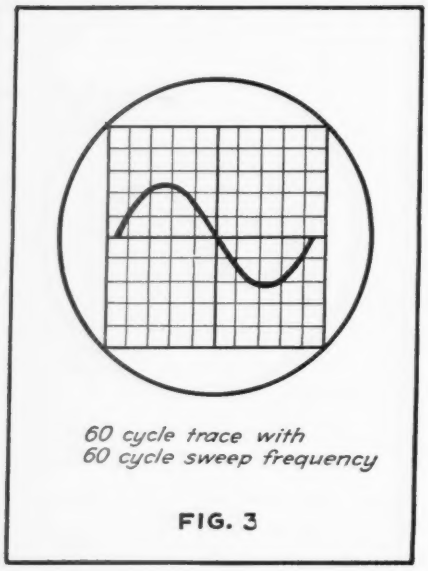


60 cycle trace with 60 cycle sweep frequency

FIG. 3

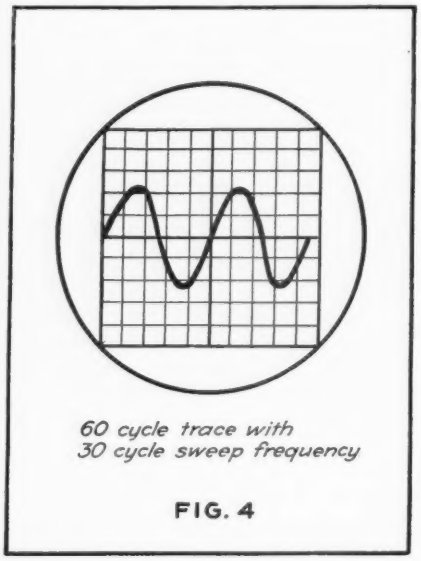
synchronizing potentiometer should be turned up slightly, and in some cases the vernier sweep slightly readjusted, until the pattern stands still on the screen. Avoid excessive synchronizing voltages to minimize sweep distortion. Figures 3 to 7 show some of the patterns that may be obtained.

Next, check the direction of the sweep to determine whether time reads from left to right as it is supposed to do. This may be accomplished in several ways. If the sweep circuit is capable of going down to very low frequencies, such as 5 or 10 cycles per second, it is possible to see the spot move across the screen and determine whether it is moving in the right direction. If the sweep frequency does not go down low enough to observe this, it is often possible to connect an additional capacitor across the largest capacitor in the sweep circuit and lower the frequency sufficiently to observe the direction. This, of course, will require removing the case temporarily to make the connections.

Another simple method is to look at some known wave shape such as the anode-cathode voltage of a phase-controlled thyratron tube. If a circuit of this sort is not available a circuit shown in Fig. 8 would be suitable for this purpose. Connect the oscilloscope across the anode and cathode of the thyratron VT1 with the ground terminal of the oscilloscope on the cathode side of the thyratron. After allowing the thyratron cathode to heat 30 seconds, close the anode switch S1 and adjust the grid bias with the potentiometer R3 until, with the tube turned partly on a trace similar to either Fig. 9 (a) or (b) is obtained. If the trace is similar to (a) the sweep is in the correct left to right direction, but if it is like (b) it is incorrect.

Another way to check sweep direction is to look at two different voltages of known phase relationship while holding the sweep in synchronism with one of them. For example, Fig. 10 (a) shows a simple circuit composed of a resistor and capacitor of approximately equal impedance (say 25,000 ohms and 0.1 mfd for 60 cycles) so that we know that the capacitor voltage measured from points 2 to 3 will be approximately 70 percent of the supply voltage measured from 1 to 3 and lagging it by about 45 degrees. Thus, if we connect the ground terminal of the oscilloscope to point 3 and connect the high side first to point 1 and then point 2, the peak of the second sine wave should be lower and to the right of the first wave, as shown in Fig. 10 (b), when the sweep is from left to right. If the second and smaller sine wave appears to "lead" the first, the sweep is backwards.

In attempting to note the relative position of two simple sine waves it



60 cycle trace with 30 cycle sweep frequency

FIG. 4

is generally possible to remember the position of the first on the screen until the second trace is observed and their relative phase relations noted. However, when two, or even more, complex waves are to be successively viewed on the screen, and a knowledge of their relative phasing and magnitudes is necessary, some form of recording is helpful. On large tubes such as the 5-in. size, one scheme used has been to use a soft "grease" pencil to sketch the successive traces directly on the end of the tube. This scheme is not practical on a small tube and even on a large tube some difficulty may result if there are many traces.

Another scheme frequently used is to place a thin piece of tracing paper over the end of the tube and sketch the trace directly on the paper. This has the advantage of providing a permanent record. Care must be taken to fasten the paper to the oscilloscope screen in such a way that it cannot move between successive traces, or some indexing scheme must be used. A disadvantage of this system is that the paper cuts down the intensity of the trace and it is sometimes necessary to remove it to see transient phenomena or any very quick voltage change which produces a faint trace.

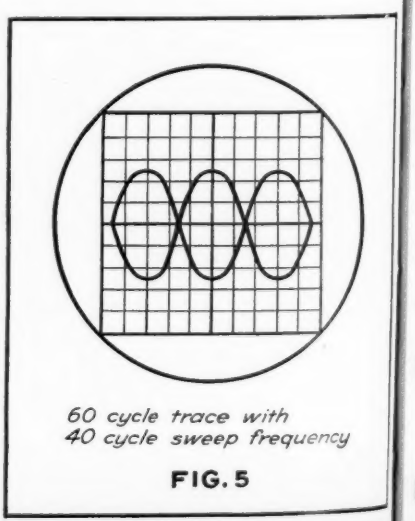
A third method is to simply sketch the observed trace on cross section paper that has cross section lines similar to the screen on the face of the oscilloscope. With a little practice this is probably just as quick as the other methods and eliminates most of their disadvantages. It has an additional advantage from the standpoint of safety since there is no necessity of touching the case of the instrument, thus minimizing the shock hazard when the case is "high" to ground.

Precautions in Using Oscilloscope

Several precautions pertaining both to personal safety and to satisfactory results should be carefully observed in the use of the cathode ray oscilloscope on industrial apparatus.

No. 1. Remember that the lower input terminal is tied to the chassis of the oscilloscope. If possible, try to connect this plate at or near ground potential on the circuit being examined, to minimize the danger of shock from the instrument case. Unless the oscilloscope has been specially insulated, do not connect this chassis side to a potential higher than 550 volts to ground or you may puncture the oscilloscope supply transformer and perhaps cause considerable damage, particularly when high current capacity circuits are being checked.

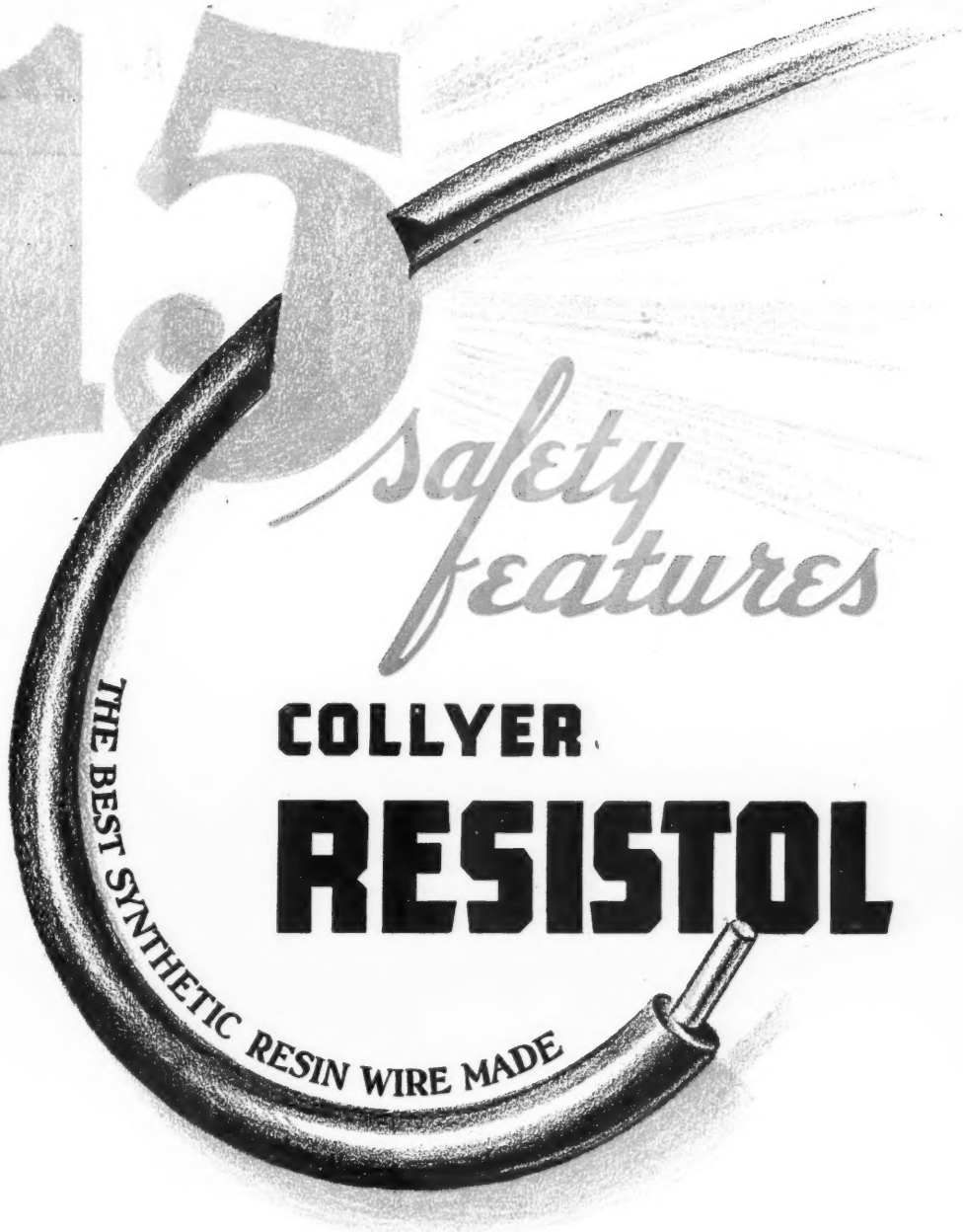
If the chassis is at any potential other than ground, care must be taken not to allow the case to short to ground. Most metal case oscilloscopes have



60 cycle trace with 40 cycle sweep frequency

FIG. 5

15 safety features



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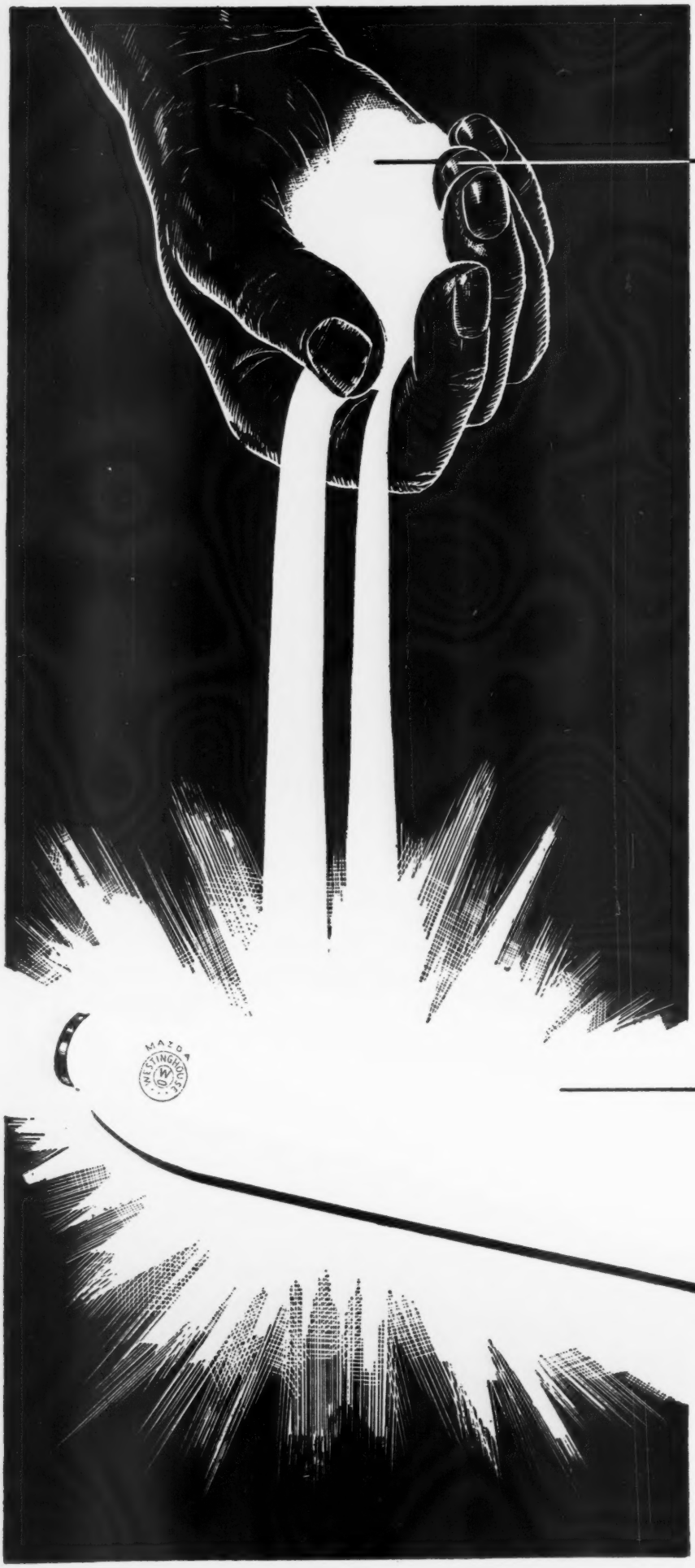
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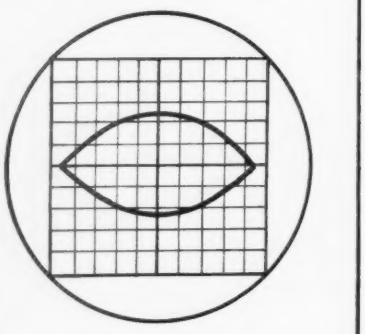
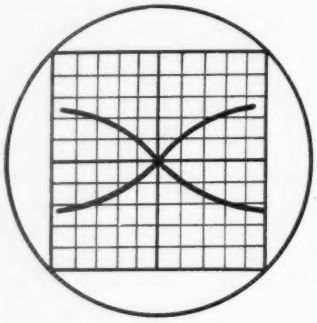


(a)

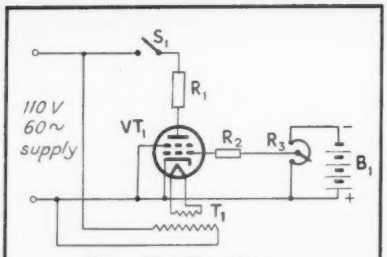


(b)

60 cycle trace with 120 cycle sweep frequency

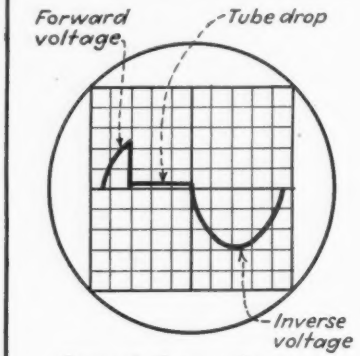
(Synchronized at different parts of cycle)

FIG. 6

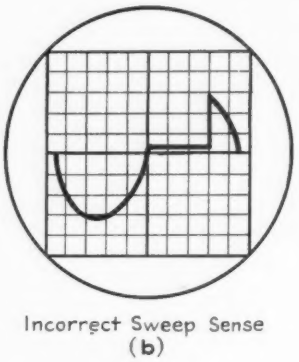


VT_1 – 2051 Thyratron
R_1 – 1,000 ohms 10 watts
R_2 – 100,000 ohms 1 watt
R_3 – 100,000 ohms 1 watt
B_1 – 22.5 volt battery
T_1 – 110 V./6.3 V. .6 amp.

FIG. 8



Correct Sweep Sense
(a)



Incorrect Sweep Sense
(b)

FIG. 9

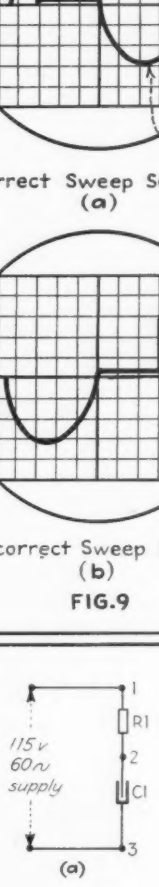
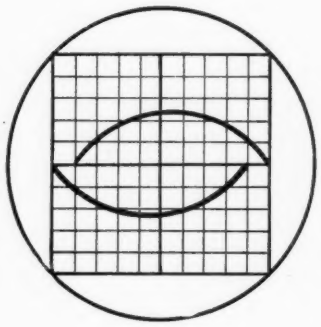
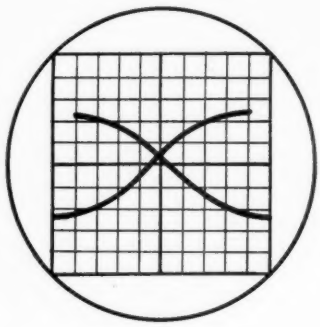


FIG. 10



(a)



(b)

60 cycle trace with 120 cycle sweep freqency showing distortion due to excessive synchronization of signal

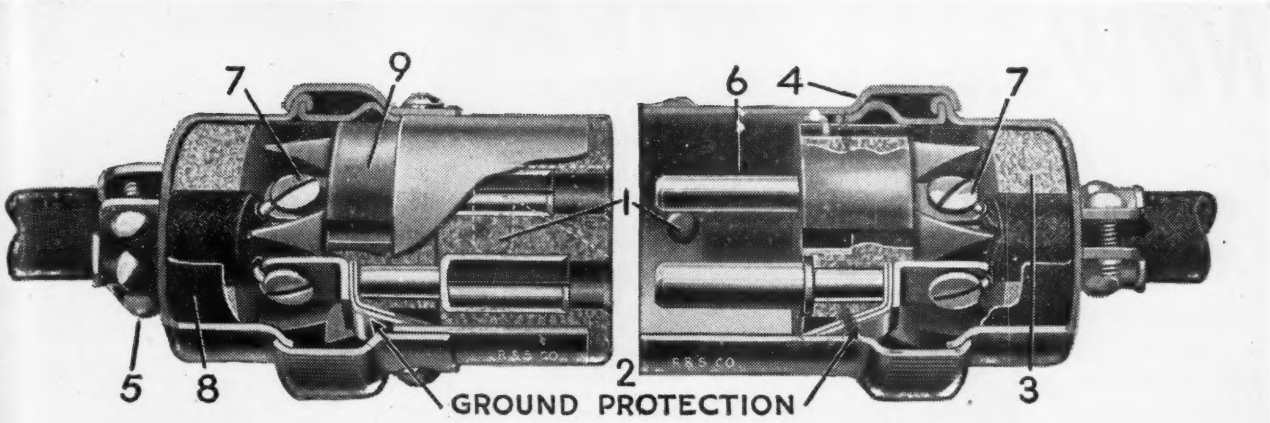
FIG. 7

rubber bumpers on the bottom to prevent marring a finished surface and these also serve to insulate the case if it is set on a metal surface. However, the bumpers sometimes come off so that it is generally safer to set the instrument on a dry board or other insulating surface whenever possible. Care should be taken in making any adjustments on the oscilloscope under these conditions, since a shock may result if the operator comes in contact with any of the metal parts connected with the case, unless he is insulated from ground.

No. 2. Since the deflecting plate connected with the chassis has considerable capacity and possibly some leakage to ground, this plate should not be connected to high impedance points in the circuit under test such as vacuum tube grids fed through large grid resistors. If this caution is not observed, the additional capacity and leakage may affect the circuit being observed so that any observations are worthless.

No. 3. Care should be taken to avoid spurious pickup which may distort the observation. In dealing with low impedance circuits near power apparatus, the chief source of trouble may be from magnetic fields. This is particularly true, for example, in working near large resistance welding machines. To check this condition, connect the "high" side of the oscilloscope to the same terminal to which the "low" side or chassis is connected. Under this condition, there should be only a straight line zero trace. If for any reason, any other deflection takes place, the oscilloscope should be moved and turned until the deflection disappears, and the trace remains at zero when any machine in the vicinity is operated. It should be noted that it is not always necessary to move completely out of a weak magnetic field. If the oscilloscope is rotated and inclined until the stray magnetic field is essentially axial, its effect on the beam will probably be negligible.

In the case of very high impedance circuits, such as photoelectric circuits, the capacity of the connection of the "high" deflection plate and the deflection plate itself, to both the "low" side and to other objects, such as ground, may cause the circuit to function improperly. In such cases, the leads should be made as short as possible and it may be desirable to shield the "high" side lead.



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2. **Positive Grounding** provides maximum protection to personnel and equipment.

3. **Dust-proof**—to exclude metal particles, dust, etc., from interiors of plugs and connectors.

4. **Steel-Clad** — Provides maximum protection. Light in weight, yet sturdy.

5. **Cord Grip** — Adjustable for wide range of cable sizes. Prevents strains on connections and protects cable.

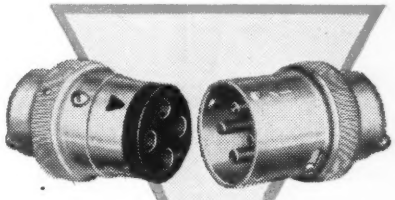
6. **Contacts** are machined, self-wiping and self-aligning.

7. **Unit Assembly**—Housing assembly plus interior assembly—easy wiring—only two pieces to handle. No screws to take out and lose.

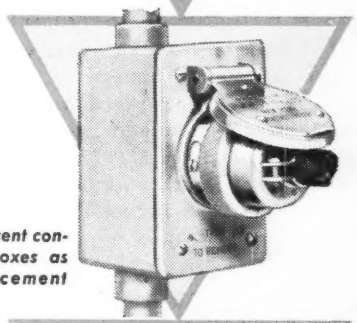
8. **Caps** fibre-lined to prevent stray wire ends touching the shell.

9. **Interiors**—molded bakelite.

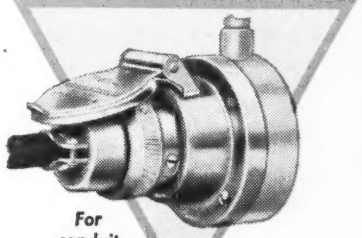
10. **Polarized** — Plugs cannot be inserted the wrong way.



The locking feature



In present conduit boxes as replacement units.



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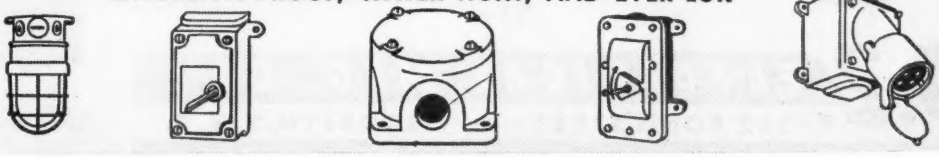

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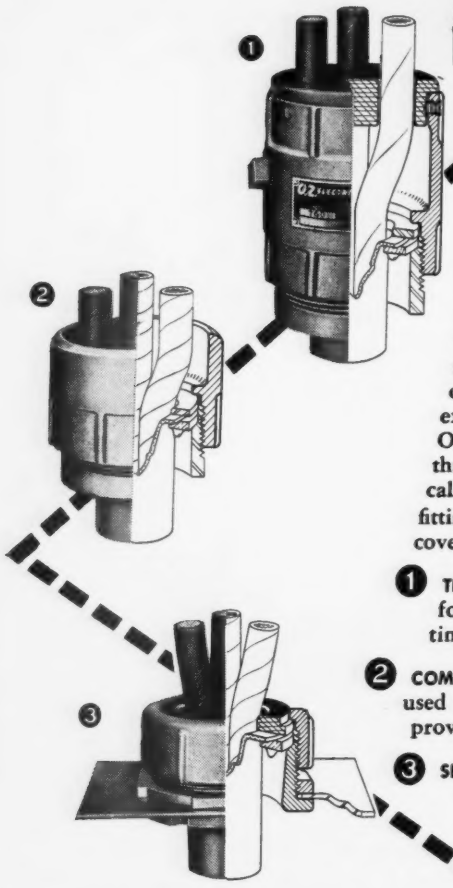

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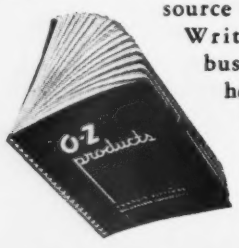

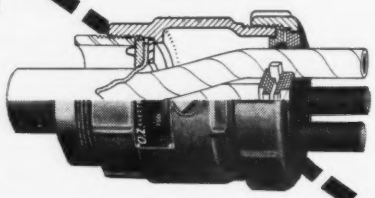

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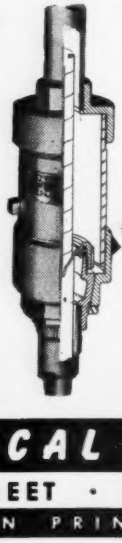

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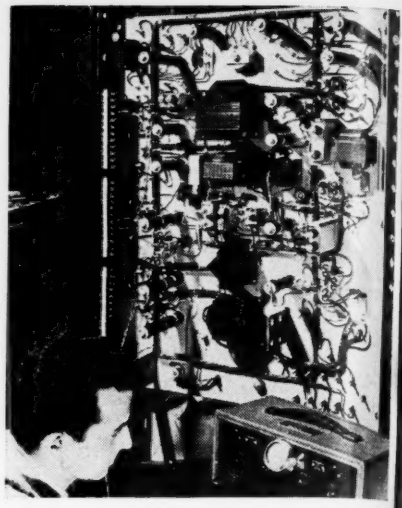
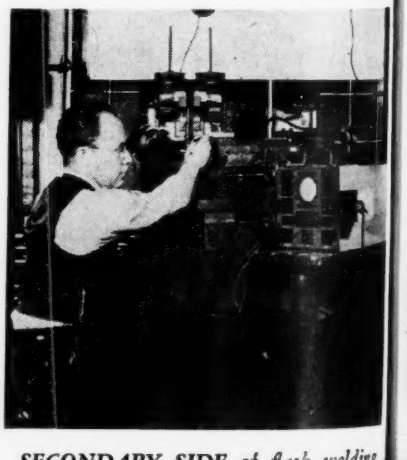


ELECTRONIC CONTROL PANEL being checked with cathode ray oscilloscope, a most useful instrument for checking wave shapes when searching for faults.

The variety of industrial electronic equipment is so great, that it is difficult to give any set procedure in checking except for specific equipments. However, you should become familiar with the wave shapes across various parts of the circuits that you will have to install and maintain.

A good trick that some maintenance men use in their spare time in familiarizing themselves with maintenance of electronic equipment is to compile a permanent record of various normal and abnormal traces on various equipments. The oscilloscope is placed at any point in the circuits where faults may occur and a permanent record made of the resulting normal traces. A fault condition is then purposely set-up (such as the insertion of a bad tube, a shorted capacitor, or an open circuit at some point) and a permanent record made of the abnormal traces so obtained. Thus, when a fault actually occurs, he can more easily and quickly analyze the situation and identify the condition causing improper operation.



SECONDARY SIDE of flash welding machine being checked with oscilloscope and voltmeter to determine open circuit voltage.

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Electronic Auxiliaries—2

Second in a series of articles about auxiliary apparatus in electronic circuits. This article discusses inductance and its uses with electron tubes.

By R. B. Immel
Westinghouse Elec. & Mfg. Co.
East Pittsburgh, Pa.

3. *Choke or Inductance Coil—(Inductive Reactance)*

When a direct current potential is applied to a choke or inductance coil as shown by Fig. 9, the current builds up or increases slowly as shown by Fig. 10 because of the self-inductance of the coil. As soon as current starts to flow in the choke coil, a magnetic field is created which induces a voltage into the coil. This induced voltage always has a polarity which tends to oppose the original current. This coil current characteristic constantly tends to oppose any change in current flow and, therefore, it requires an appreciable time for the current to reach its steady state. When a steady value of current is attained, the inductance has no effect and the current is limited only by the resistance of the circuit.

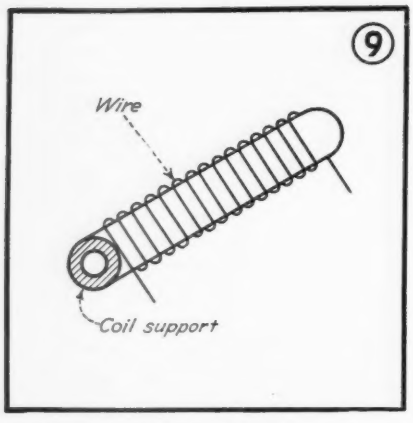

FIG. 9. Choke or inductance coil.

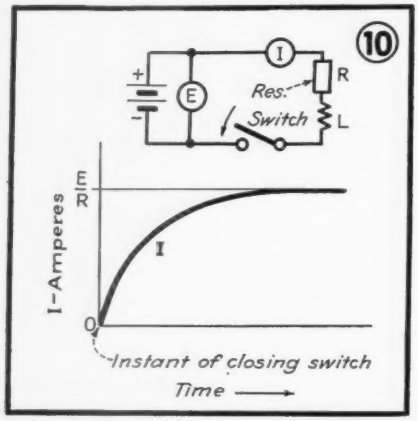

FIG. 10. Current time characteristic of the formation of a magnetic field.

An inductance has the characteristic of being able to store electrical energy in the form of a magnetic field. When the magnetic field collapses, the energy stored in the field is returned to the circuit in the form of a current or high voltage discharge. As shown by Fig. 11, the current through the coil decreases slowly when the coil is discharged through a resistance by short-circuiting the coil circuit.

One or more choke coils are often connected in series with a pulsating direct current power source, such as a half-wave rectifier, to smooth out the pulsations and ripples. This is accomplished as the self-inductance effect of a coil acts similar to the inertia effect in a mechanical system and prevents rapid changes in the current flow.

The inductance of an air-core coil is proportional to the square of the number of turns and the cross-section area of the coil; it is also inversely proportional to the length. The formula for inductance is:

$$L = \frac{k\ N^2\ A}{l}$$ where

L = inductance in henrys
k = equation constant
N = number of turns
A = cross-section area in square inches
l = length in inches

The inductive reactance of a coil may be greatly increased by winding the coil on a core of magnetic material. The above equation for inductance does not hold for any except air-core coils.

When an alternating current potential is impressed upon a choke coil, the reactance is directly proportional to the frequency since the greater the rate of change of current, the greater the impedance or opposition to the current flow. The inductive reactance of a choke coil on alternating current is:

$X_1 = 2\pi f L$ where

X_1 = inductive reactance in ohms
f = frequency in cycles per second
L = coil inductance in henrys
$\pi = 3.1416$

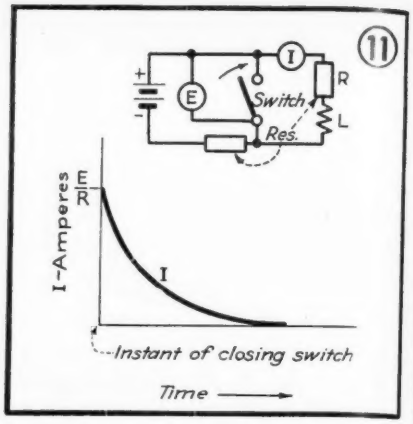

FIG. 11. Current-time discharge through resistance characteristic of magnetic field.

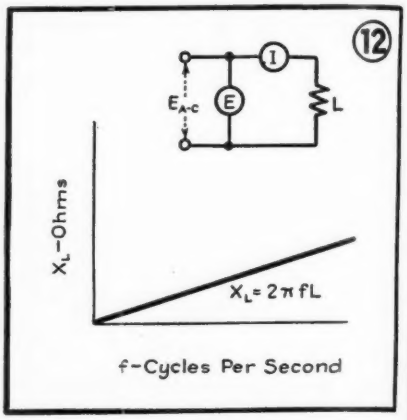

FIG. 12. Frequency-impedance characteristic of an inductance coil.

Fig. 12 shows the change in inductive reactance with a change in frequency. The inductive reactance in the above formula is always considered positive.

In an inductive circuit with negligible or zero resistance, the current lags the impressed voltage by practically 90°. This characteristic of the relationship of current and voltage is shown by Fig. 13.

As an inductance coil offers a high impedance to high frequency currents, it may be used to suppress or block out high frequencies in a circuit network. Because the impedance and voltage drop across the coil varies with the frequency, these coils are often used to provide automatic compensation for changes in frequency for an amplifier network. An inductance coil may also be employed to shift the phase angle between the current and voltage. Phase shifting coils are often used to control the firing of a thyratron or ignitron tube. It is also quite common to use an inductance coil to provide a

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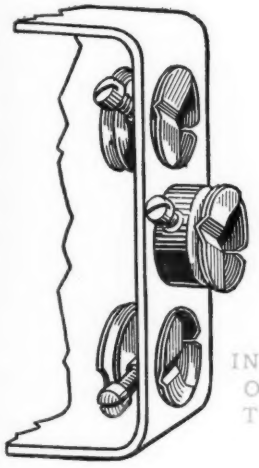

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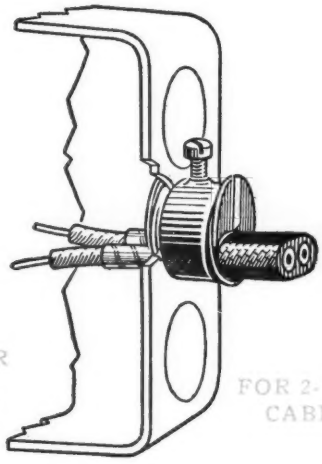

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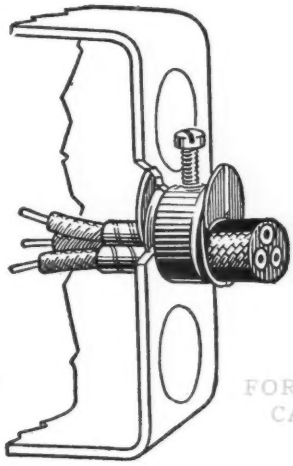

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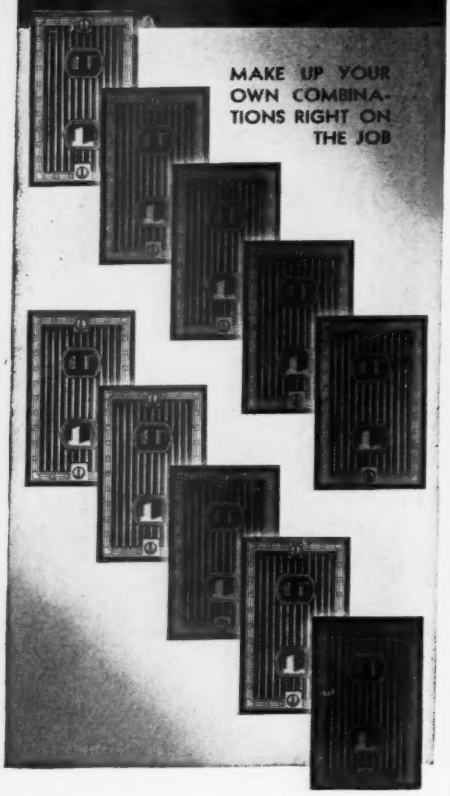

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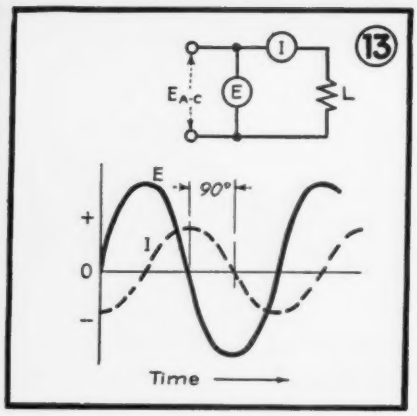


FIG. 13. Current-voltage phase relationship of an inductance coil

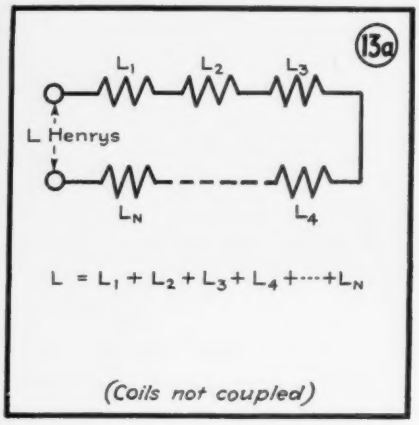


FIG. 13a. Inductance coils connected in series—formula for total inductance

time delay characteristic for the widely used inductive time delay relays on direct current circuits.

A series connection for inductance coils is shown by Fig. 13a. The total inductance is equal to the sum of the individual inductances.

Fig. 13b illustrates a circuit in which the inductances are connected in parallel and gives the formula for the calculation of the total inductance. For only two inductances connected in parallel the following formula may be used:

$$L = \frac{L_1 L_2}{L_1 + L_2}$$

It should be noted that the formulas for the calculation of inductance are very similar to those for series and parallel resistor connections. The inductance formulas do not hold true when the magnetic field of one inductance coil links or reacts with another coil or its magnetic field.

It should be noted that the capacitive reactance of a condenser and the inductive reactance of a coil are oppositely affected by a variation in frequency in an alternating current circuit. For any combination of capacitance and inductance there is one definite value of frequency at which the capacitive and inductive reactances are equal. Since these two

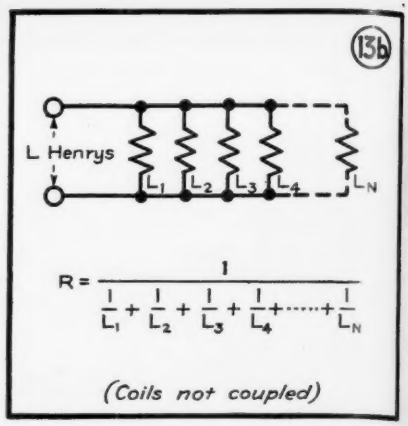


FIG. 13b. Inductance coils connected in parallel—formula for total inductance

reactances are equal and opposite in effect, the net reactance of the circuit is zero. The resistance of the circuit under these conditions offers the only impedance to the current flow. When this phenomena of zero reactive impedance occurs, the circuit is said to be in *resonance* and the frequency at which this condition occurs is called the *resonant frequency* of the circuit. This type of circuit net work is often used in radios to make the circuit selective and responsive only to a certain signal frequency or to prevent response to a certain frequency.

Certain combinations of condensers and inductance coils are used in electrical oscillators to provide the oscillation means. A resonant circuit in an electrical system is analogous to a pendulum in a mechanical system. Similar to the continued oscillation of a pendulum after the driving force has been disconnected, the electrical energy oscillation in a resonant circuit will continue for a time after the source of power has been removed. These two phenomena occur since the kinetic energy of the mechanical system furnishes the force to keep the pendulum swinging and the energy stored in the electric and magnetic fields of a condenser and an inductance coil provide the means for continuing the current flow.

★ BETTER WIRING FOR BETTER LIVING ★

Where was Mary when the lights went out?

THIS month we bring you another touching episode in the history of the Bjones family—who built a dream home, only to have it turn into a nightmare.

Upstairs, Mr. Bjones is entertaining (?) his boss—trying to make light conversation in a house as *dark and dismal* as Schickelgruber's future.

And where is Mary Bjones? Alas, she's down in the cellar fussing and fumbling with fuses—*wondering why life is just one darn fuse after another!*

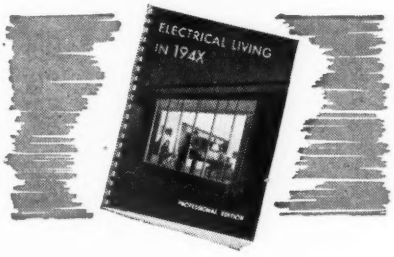
There are three reasons for the trials and tribulations of Mr. and Mrs. B . . .

First—their home was *inadequately wired* to carry the electrical loads imposed by modern lighting and electrical appliances.

Second—their home was not equipped with *modern circuit protection*—they could not restore electric service, at the flip of a switch, after the trouble was corrected.

Third—their home did not have modern circuit protection—*conveniently located*—they had to go to the "hard to get to" protective device in the cellar.

We have prepared a new book—"Electrical Living in 194X"—that will help you explain the urgent need for *better wiring* and *modern protection* to present and future home owners.



"Electrical Living in 194X" tells all about increased electrical loads in future homes—modern circuit protection—lighting and lighting controls—entrance equipment and distribution panels.

This big, profusely illustrated, 64-page book is free! Get your copy now, by writing Better Homes Department (EC-64), Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pa.

BETTER HOMES DEPARTMENT

Six Point Advisory Service

. . . offers free technical advice on the selection, application, and arrangement of fixed electrical equipment in 194X homes—dimensions and clearances, for proper installation and easy access for servicing—placing of lighting outlets and controls—location and size of wiring, water supply, and drainage lines.

Send your electrical problems to the Westinghouse Better Homes Department. Our housing specialists will give you authoritative information, promptly.

Westinghouse

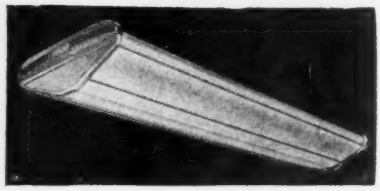
Plants in 25 Cities ***Offices Everywhere***

WESTINGHOUSE PRESENTS ***John Charles Thomas, Sunday, 2:30 p.m., E.W.T., NBC. "Top of the Evening", Monday, Wednesday, Friday, 10:15 p.m., E.W.T., Blue Network***

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS

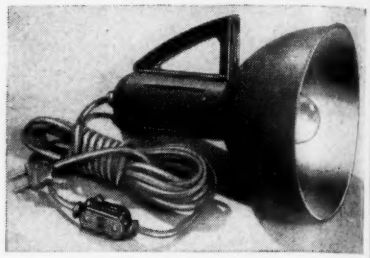
Fluorescent Fixture



GUTH FLUORESCENT FIXTURE

A new fluorescent fixture, known as Excelux, is for use in administration areas, general offices and drafting rooms. Low surface brightness is effected with high overall lighting efficiency. Full-screen diffusion is provided through a diffusing-shield, which consists of contiguous, multiple prisms. This unit is used with four 40 watt fluorescent lamps. Convenient relamping is provided by means of a retaining end-hinge, which permits the shield to be easily removed from the fixture chassis. The shield is securely held within its cradle at all times. It is available for unit type installations in close ceiling and suspension models. The Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.

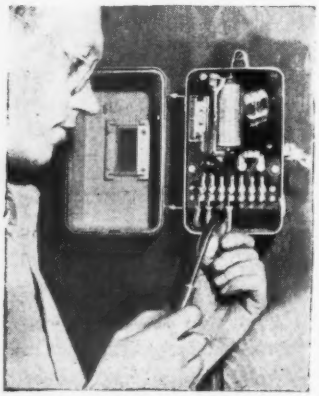
Infra-Red Unit



FOSTORIA INFRA-RED UNIT

Model LRJ-3 is a new infra-red unit for quick heating. It is complete with lamp, reflector, cord and plug, and off-on switch. It is recommended for use in industrial plants where quick, easy, controlled heating is required. It uses a 375 watt 100 volt carbon filament infra-red lamp of medium screw base PS-30 type. Unit operates on a.c. or d.c. current. Some of the uses are soldering operations; melting or flowing grease, pitch, oils; preheating materials; rapid drying; touch-up paint finishing; heating soldering lugs for electrical connections and thawing frozen oxygen regulators; thawing frozen pipes; removing paint from wood; and reflow carbon on carbon paper to increase life. The unit can be purchased on priority ratings of AA-4 or higher. The Fostoria Pressed Steel Corporation, Fostoria, Ohio.

Electronic Relay



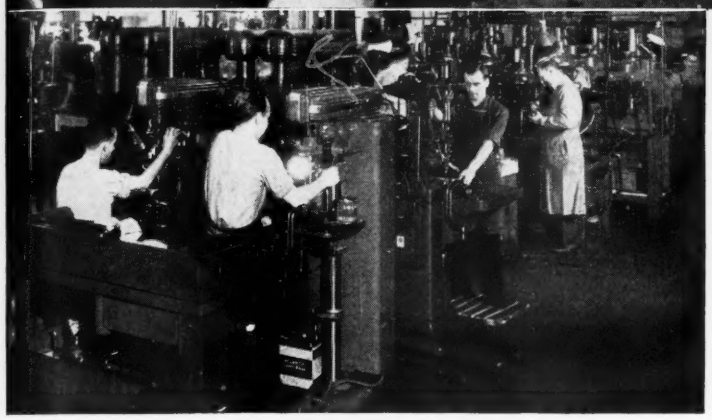
G-E ELECTRONIC RELAY

A new electronic relay for amplifying very limited current transmitted by delicate control contacts or high resistance circuits, has been announced. Operated by any material having a resistance of from 0 to 500,000 ohms, or even greater if necessary, the new relay is especially suitable for controlling liquid levels in tanks and boilers, sorting metallic parts by size, detecting broken threads in textile machines and as a limit switch requiring light pressure to operate. It consists of a standard type electronic tube, a supply transformer, and an electromagnetic relay—all mounted in a totally enclosed, weather-resistant enclosure suitable for wall or machine mounting. In operation, the electromagnetic relay in the device is kept energized as long as the controls connected to the input grid circuit of the electronic tube remain open. The instant these contacts close, the relay is de-energized. A contact arrangement on the electromagnetic relay permits the device to be used either to make or break a load circuit when the actuating contacts connected to the input circuit on the electronic relay are closed. General Electric Company, Schenectady, N. Y.

Silver Mirror Reflector

CURTIS REFLECTOR

This new reflector of the 750 watt bi-post lamp is for use in airplane hangars, ordnance plants, armories and general factory and high bay installations. The finish is gray on all metal parts and golden armor on the reflector. Lamp is not included with unit. Catalog No. 587-T is supplied with a heavy gauge steel band which supports the reflector and absorbs shock of blow which might damage the reflector. It is also supported at the neck by spring clips forming part of the tripod holder arrangement. A duplex hanger may be used with this reflector whenever the unit is to be hung in pairs. Curtis Lighting, Inc., 6135 West 65th Street, Chicago 39, Ill.



Here is the Steel Products Grinding Department at Doyle Machine and Tool Corporation. A shutdown here stops production and makes operators stand idle—but overhead and wages continue to pile up.

Drill Department. Another spot where a useless shutdown can be very costly in lost production, wasted man-hours, and needless overall expense.

Here is another outstanding example that demonstrates how Buss Super-Lag fuses are helping to keep production running smoothly, how they reduce lost man-hours, and save trouble and grief for electricians and maintenance men.

If you have a problem similar to the one at Doyle Machine and Tool Corporation, doesn't this example indicate how you can profit by the use of Buss Super-Lag fuses?

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

Prevent future trouble in your plant—by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

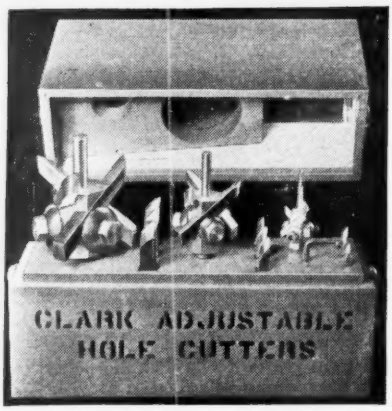
BUSSMANN MFG. CO., St. Louis 7, Mo.
Division McGraw Electric Company

FUSES Sold Through Wholesalers

Fluorescent Unit

CURTIS FLUORESCENT UNIT

The "Bedford" fluorescent units are designed for use in offices and drafting rooms, and for certain industrial lighting applications—either as an individual unit or for continuous rows. These units have square ends and can be joined together with flexible steel straps which hide the joints and prevent light leakage. They may be mounted flush on the ceiling, or recessed above it, with or without a louver. For some industrial installations the units can be suspended by means of chain, conduit or cable. The ballast is mounted on top at the center and starters are grouped at one end. Units are available for two or three 40 watt fluorescent lamps. Curtis Lighting, Inc., 6135 West 64th Street, Chicago 38, Ill.

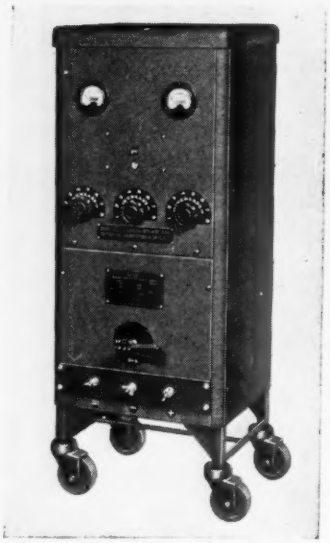


CLARK ADJUSTABLE HOLE CUTTER

on the larger sized tools are removable and may be replaced with lead drills if desired. Robert H. Clark Company, 9330 Santa Monica Boulevard, Beverly Hills, Calif.

Portable Power Supply

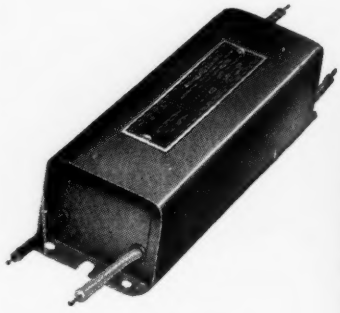
This portable d.c. power supply is designed for use on assembly lines, in laboratories and maintenance departments. It provides a dependable source of portable d.c. power for manufacturing, testing and operating all electrical and electronic equipment in aircraft and other units employing 12 or 24 volt systems. The power supply can also be used to taper charge batteries or battery carts of similar voltages. The unit is designed to operate from 3 phase a.c. lines of 208 and 230 volts. Three models are available: No. VA1500, with d.c. output of 10 to 16 volts at 100 amperes or 20 to 32 volts at 50 amperes; No. VA3000, with d.c. output of 10 to 16 volts at 200 amperes or 20 to 32 volts at 100 amperes; No. VA4500, with d.c. output of 10 to 16 volts at 300 amperes or 20 to 32 volts at 150 amperes. Models with similar d.c. output but for operation on 460 volts a.c., are also available. P. R. Mallory & Co., Inc., Indianapolis 6, Ind.



MALLORY POWER SUPPLY

Fluorescent Ballast

This new quick-start ballast is for instant starting fluorescent lamps. It is available in dual 40 watt size for two 40 watt lamps, in either end-lead or bottom-lead designs. Operating from standard 115/120 primary circuit it boosts the voltage to approximately 450 volts for lamp starting. It is claimed that when used in connection with the new "Instant Start" fluorescent lamps no sacrifice is made in the accustomed operating advantages or lamp life. However, if used for other than "Instant Start" type lamps, lamp life is variably reduced. Old type fixtures may be changed to "Quick Start" by replacing old type ballasts with this new design and installing the new "Instant Start" type fluorescent lamps. The Acme Electric & Mfg. Co., Cuba, N. Y.



ACME BALLAST

Hole Cutters

A new set of three adjustable hole cutters that cut all possible diameters from $\frac{5}{8}$-in. to $3\frac{1}{2}$-in. is announced. These cutters, with straight shanks for use as hand tools, in portable electric and pneumatic drills, produce clean holes that require no after-grinding, reaming or filing. They may also be used in lathes and other spindle-type machines. The cutters consist of a straight shank on a hexagon body, into which are set three high-speed steel blades at 120° intervals. Shanks are heat-treated and the three blades are precision-ground high-speed steel. The hardened and ground pilots

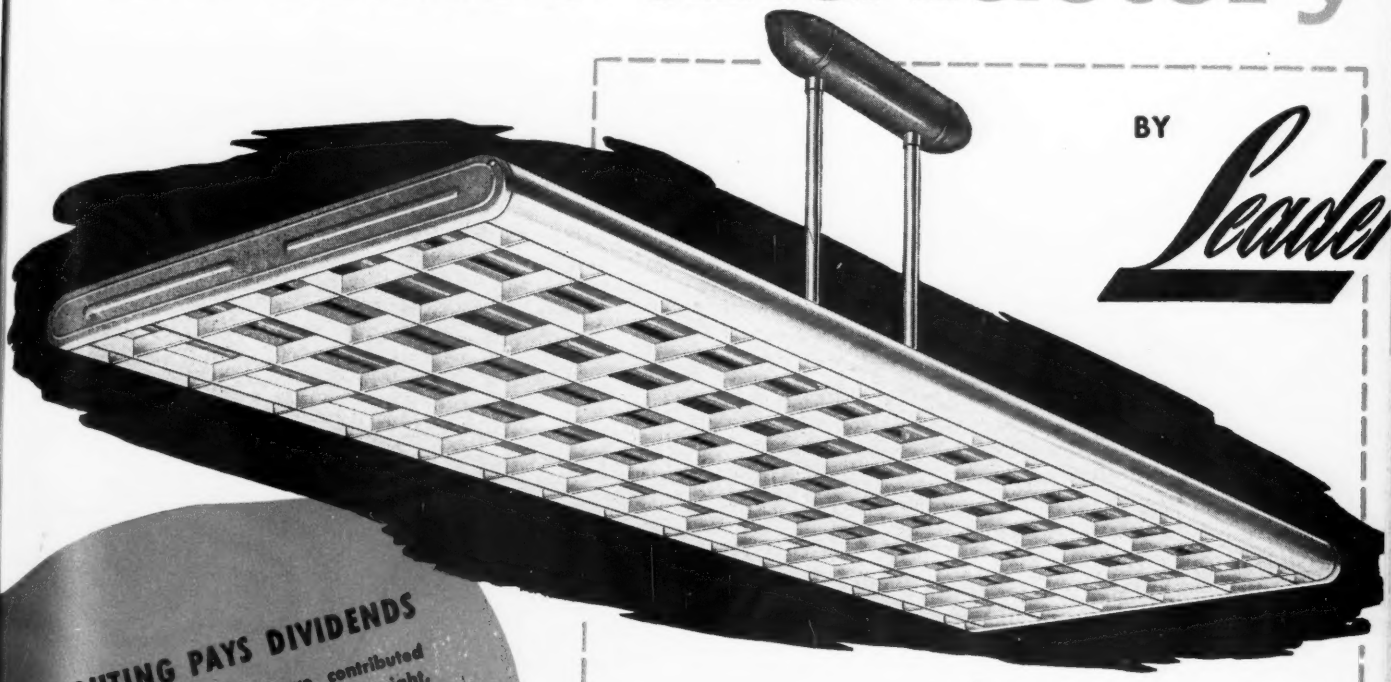
Folding Ladder

DUO-SAFETY FOLDING LADDER

Series "G" is a heavy - duty, lightweight folding ladder. Special lock keeps ladder rigid in the open position. It is equipped with safety shoes, providing maximum safety while working on all types of surfaces. This new type of folding ladder is easy to handle because of its light weight and compact banking—it folds into a bundle 3-in. by 3-in. It is available in lengths from 6 ft. to 20-ft. Duo-Safety Ladder Corp., Oshkosh, Wis.

complete re-lighting of office and factory

BY Leader



RE-LIGHTING PAYS DIVIDENDS

Leader Fluorescent fixtures have contributed more efficiency, more production, better sight, better living to America's huge industrial plant. It has been well demonstrated that good light pays dividends.

Foremost in the fluorescent field, Leader Units are the standard when lighting is being considered. You owe it to yourself to investigate Leader quality.

Leader Units are engineered for the best in lighting . . . efficient installations . . . low maintenance costs.

NOW STEEL REFLECTORS AND HEAVIER CONSTRUCTION

In line with current events, Leader Units are now available with all steel heavier construction throughout. This is important . . . it adds rigidity and lower maintenance costs.

VL-440: The LEADER OFFICER — Four light 40 watt plastic enclosed, louvred unit, combining the finest in design, construction, and servicing feature, this unit offers the ultimate in lighting equipment. Available for pendant or ceiling suspension mounting, individual or continuous run installation.

ZUO Series: Sturdy, streamlined industrial units available in two and three light 40 watt units and two light 100 watt units. Rigid all steel construction. Designed for individual or continuous run installation.

"A STEP AHEAD" LEADER ELECTRIC MFG. CORP.

Write for Descriptive Literature or Consult a Leader Engineer

LEADER ELECTRIC MANUFACTURING CORPORATION

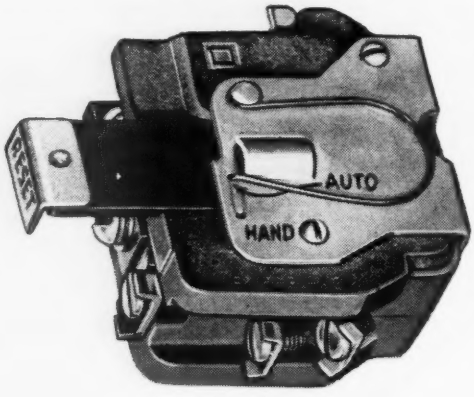
6127 N. BROADWAY • CHICAGO 40, ILLINOIS

Insulating Varnish

A new flexible insulating varnish known as R-851 has been developed. It is designed for applications that demand great lead wire flexibility in addition to high mechanical strength. It is also recommended for coating armature and stator coils that will be stored for long periods before assembly. This clear baking varnish dries completely throughout when baked at a temperature of 135° C. The dried insulation is oilproof and affords a protection that is water, acid and alkali resistant. It is particularly recommended for electrical equipment wound with glass covered wire designed to operate at high operating temperatures. The Sterling Varnish Company, 122 Ohio River Blvd., Haysville, Pa.

Overload Relay

A new bimetallic overload relay which provides a positive method of changing from automatic to hand reset, has been announced. One of the features is a simple means of adjusting the tripping point from 85 to 115 percent of nominal rating. Thus changes can be made in settings to take care of variations in ambient temperature or load conditions at the motor. These new Type AR relays designed for separate mounting or front mounting on Size O and I starters, are needed whenever starters are mounted in remote or inaccessible locations. They are particularly well suited for use in built-in machine tool control. Industrial Controller Division, Square D Company, Milwaukee, Wis.



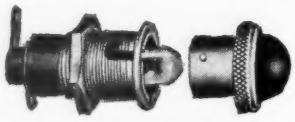
SQUARE D RELAY

Speed Indicator

The Jaeger speed indicator is for measuring locational and surface speeds of various kinds of mechanical equipment. It consists of a special non-magnetic watch movement combined with a simple form of revolution counter in such a way that the revolutions are timed for exactly six seconds. As this is proportional to the revolutions per minute, the scale is calibrated in r.p.m. There are two ratings of the instrument, one for all speeds up to 2000 r.p.m. and the other for speeds up to 10,000 r.p.m. To operate, hold the instrument and place the spindle, with suitable tip attached, in the center of the shaft under test. The spindle will rotate, but the hands will remain stationary. The spindle should be parallel with the shaft under test. When ready to measure the speed, press the button on the side of the instrument and release it quickly. The hands will then rotate and after six seconds will stop automatically at points on the dial which show the average speed in revolutions per minute during the testing interval. The hands will remain in this position as long as desired. James G. Biddle Company, 1211 Arch Street, Philadelphia 7, Pa.

BIDDLE SPEED INDICATOR

Indicating Light



KIRKLAND INDICATING LIGHT

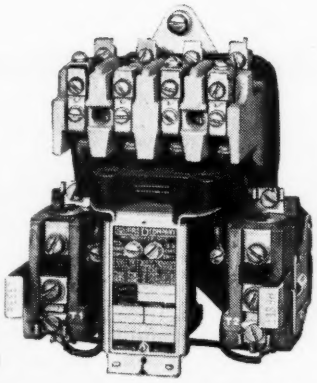
A new T3-BLC Indicating Light Unit, with a bayonet-locked lens-cap, has been announced. It is for use with a T3¼ type single-contact bayonet lamp bulb and embodies a new design of lamp socket, free from press-fit methods of assembly and providing a direct electrical connection from the shell and the center contact pin to the terminal spades. The lens-cap is inserted and held in place as is a bayonet type lamp bulb. It is recommended for use on applications where excessive shock and vibration are to be contended with. This unit is for single hole mounting on a panel. The H. R. Kirkland Company, Morristown, N. J.

Ballasts

G-E STREAMLINE BALLASTS

A new line of Tulamp 40 watt ballasts housed in streamline, drawn-steel cases for fluorescent fixtures has been announced. The ballast is arranged for external mounting atop the fixture with leads out of the bottom of the ballast case. This makes possible the installation of ballasts atop a very narrow and shallow wiring channel in an exposed position and allows appreciable reductions in the amount of critical metal required for the fixture. As this ballast is for external mounting, it operates in lower ambient temperatures. Tulamp streamline ballasts comply with all local regulations concerning power factor and do not differ electrically from conventional ballasts of corresponding ratings. General Electric Company, Schenectady, N. Y.

SQUARE D *Announces*
A NEW OVERLOAD RELAY



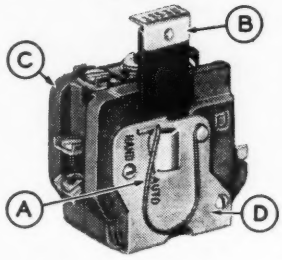
FOR SEPARATE MOUNTING— OR FRONT MOUNTING ON SIZE 0 AND 1 STARTERS

New Type AR Overload Relays provide an easy yet positive method of changing from automatic to hand reset. Adjustability of the tripping point affords greater accuracy of overload protection and flexibility of application. Terminals are large and easily accessible.

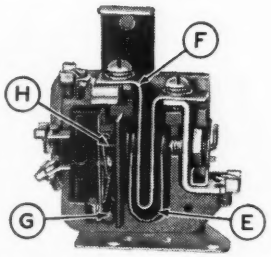
Automatic reset overload relays are useful whenever starters are mounted in remote or inaccessible locations. They are particularly well suited for built-in machine tool control because they eliminate costly external reset mechanisms. No extra charge is made for these automatic reset devices on starters or machine tool control panels.

For complete details call in your Square D Field Engineer or write for Bulletin 201. Industrial Controller Division, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

AUTOMATIC RESET

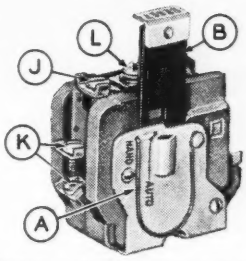


With spring wire clip (A) in hole marked "Auto" and reset slider (B) depressed, relay is in automatic reset position. Insulation blocks (C) are cold molded non-carbonizing material, wax impregnated to prevent absorption of moisture. Steel reinforcing plate (D) protects against breakage and serves as front mounting bracket.

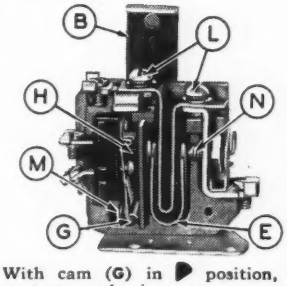


Floating bimetal trip element (E) is "U" shaped to fit around heater (F). This unusual design automatically compensates for any slight variation in shape or location of heater. Change in ambient temperature has little effect on the high temperature bimetal. With cam (G) in ◀ position, contacts will automatically reset after bimetal cools and releases tripping pin (H).

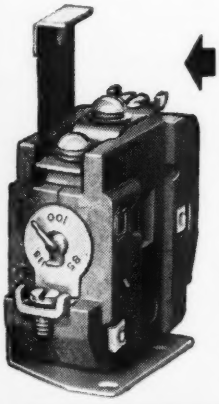
OR HAND RESET



Moving spring wire clip (A) to hole marked "Hand" releases reset slider (B) and provides hand reset operation. Note husky size of load terminal (J) and control terminals (K). Heater units are firmly attached by screws (L) but are easily installed or removed from the front even after starter is mounted and wired.

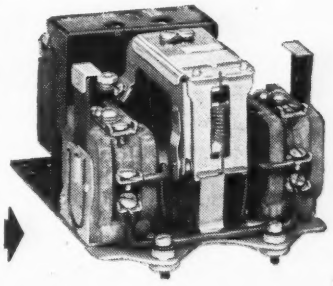


With cam (G) in ▶ position, the contact mechanism goes overcenter when trip pin (H) is pushed as bimetal (E) expands with heat. Silver contact tips at (M) remain open until operation of reset slider (B) turns cam (G) to ◀. Mechanism is trip-free, thus the snap action contacts cannot be held closed against an overload. Note screw (N) which serves as stop for bimetal, also providing adjustment.



Simple means for adjustment of the trip point from 85% to 115% of nominal rating is a valuable and unique feature of this new Type AR overload relay. It permits changes in setting to take care of variations in ambient temperature or load conditions at the motor. In addition, overload protection is not limited to the usual selection of heater sizes since intermediate points can be obtained, easily and quickly.

Type AR relays are designed for maximum accessibility and ease of wiring. Photograph of starter shows how load terminals are out in front for easy wiring, while control terminals are at bottom, away from other parts. Thus, it is very easy to connect overload relays of several starters in series, or to wire additional relays in the circuit. Likewise, it is easy to convert a standard starter to 2 wire separate control.



ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

IN THE NEWS

T.E.C.A. HOLDS MEMPHIS CONFERENCE

With a registration of more than 50 the Tennessee Electrical Contractors Association held its Sixth Annual Conference at the Claridge Hotel, Memphis, May 16th and 17th. Two highly interesting and thought provoking sessions were built around round-table informal discussions of purely local contractor and industry problems.

Speaking at the opening session, L. W. Davis, general manager, NECA, Washington, D. C., outlined the NECA reorganization plans, approved at the April meeting of the national organization in St. Louis, and stressed the vital part that local chapters will have in future operating policies of the association. Stating that the electrical contractors' part in war construction has raised the dignity and acceptance of the electrical contractor as an important phase in the construction industry, he reiterated the need for an aggressive promotional program to sell the services of the electrical contractor in the postwar era. Our industry obligation to re-train and take back into the fold returning veterans will require a much broader apprenticeship training program to accommodate these men; an immediate detour from the well worn path of "postcard contracting"—waiting for business to come over the transom; and an aggressive and honest effort to get out and create new business, he concluded.

Such important local problems as state and local licensing laws, privilege taxes, appliance merchandising taxes, overlapping of local licensing fees, utility relations and other considerations were given a thorough airing at the informal round-table session. Those present learned much from the interchange of experience offered by members from different parts of the state. J. A. Fowler, Fowler Electric Co., Memphis, a recognized authority on house wiring and housing problems, revealed a need for 5000 new homes in Mempis alone, even if all war workers are lost and no gains in new families occur during the postwar period. With the South anticipating a great postwar influx of industrial projects, based on present indications and inquiries and low cost power and heat, the demand for housing will grow, he warned.

After lengthy discussion, proposed amendments to the by-laws and reorganization of the association as a state chapter of NECA was deferred until a later date, contingent upon further discussion of local chapter problems.

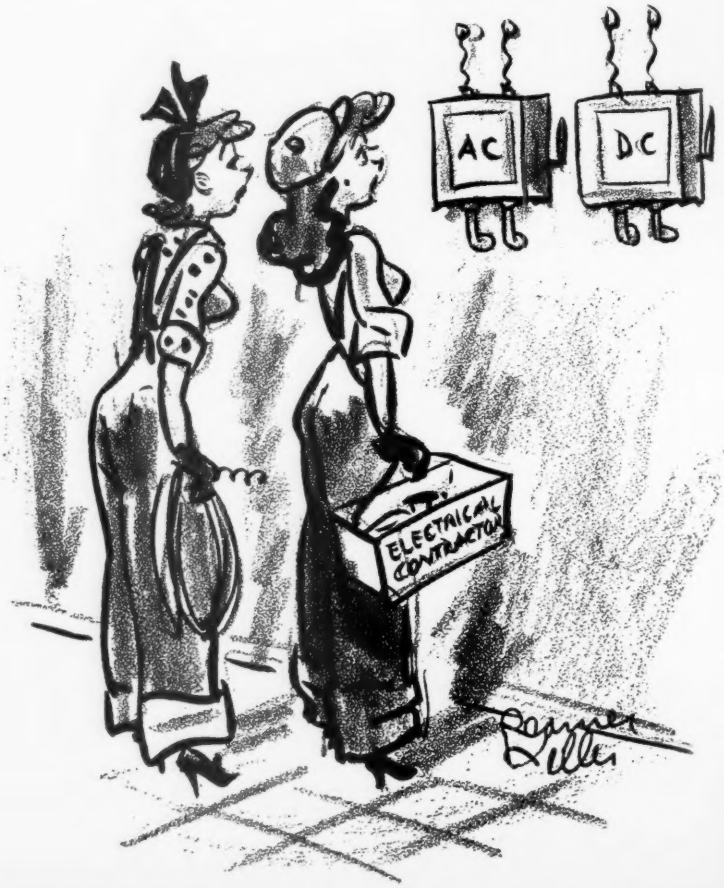
Addressing a joint conference dinner with the Memphis Electric League, Major Thomas H. Allen, President, Memphis Light, Gas and Water Division (a municipal utility), outlined the operating policy of his company—a policy that warmed the heart of every contractor and dealer present. Briefly, the basis of operation embodied the following salient features: (1) to improve service and through reduction of operating expenses, cut rates; (2) never to compete with the business enterprises of citizens of the municipality—hence they will not compete with appliance dealers and repair shops or electrical contractor; (3) to promote adequate wiring to assure the customer of getting the type of wiring he needs. Although his company maintains a small appliance repair department for customer convenience, Major Allen would like the contractor or dealer to do this work—if he will. Contractors and dealers, prone to go after only highly profitable business, must give and maintain service—however small it may be—he concluded.

Prior to the final conference session the delegates were treated to an inspection trip through the fabricating and assembly plants of the Pidgeon-Thomas Iron Company, prime contractors on the construction of LCT-6 landing craft for the Navy. Here they were privileged to follow, from layout to launching, the construction of these vital craft. Of unusual interest was the electrical installation done by the Tri-State Armature and Electrical Works of Memphis under sub-contract to the Pidgeon-Thomas Company.

Officers of the Tennessee Electrical Contractors Association elected at the final business session are: president, Albert C. Gross, Memphis; 1st vice-president, W. G. Hoffman, Knoxville; 2nd vice-president, W. J. Jewel, Chattanooga; 3rd vice-president, J. M. Stansel, Nashville; secretary-treasurer, Philip Sweet, Chattanooga. Retiring president is Ray Edenfield, Nashville.

Re-elected to the executive committee were C. R. Wright, Knoxville, and J. M. Townsend, Jackson. Other members include J. M. Stansel, Nashville; Herbert Haile, Chattanooga; and A. J. Thompson, Memphis.

The 1945 Annual Meeting will be held at Knoxville, Tenn., the exact date to be determined later.



"The D.C. stands for District of Columbia but the A.C. has me stumped!"

PORCELAIN PROTECTED WIRING SYSTEMS

★ Porcelain as an unequaled insulating material was used as early as 1890 and its place of importance in the electrical industry grew with the years.

Modern Porcelain Protected Wiring is today's safest and most reliable wiring method. It has proved its practicability over a greater period of time than any other wiring method and has progressively developed and modernized. It has always provided for greatest efficiency, adaptability, permanence, economy, and safety.

Modern Porcelain Protected Wiring Systems are the logical ones to specify and use to assure customers the very finest in wiring results. Porcelain too conserves vital materials for victory.

For good business and better customer relations, get the benefits for yourself and customers that porcelain makes possible.

Quick installations are accomplished — economical results are realized — complete insulation and protection from the entrance switch to the very last outlet on the system—short-proof and shock-proof qualities of porcelain contribute to dependability—rust and corrosion resistance characteristics make porcelain the ideal material in damp, wet, or dry locations—porcelain insures permanency and adequacy.

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Macomb, Ill.

★ **PORCELAIN PRODUCTS, INCORPORATED**
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★ **UNIVERSAL CLAY PRODUCTS COMPANY**
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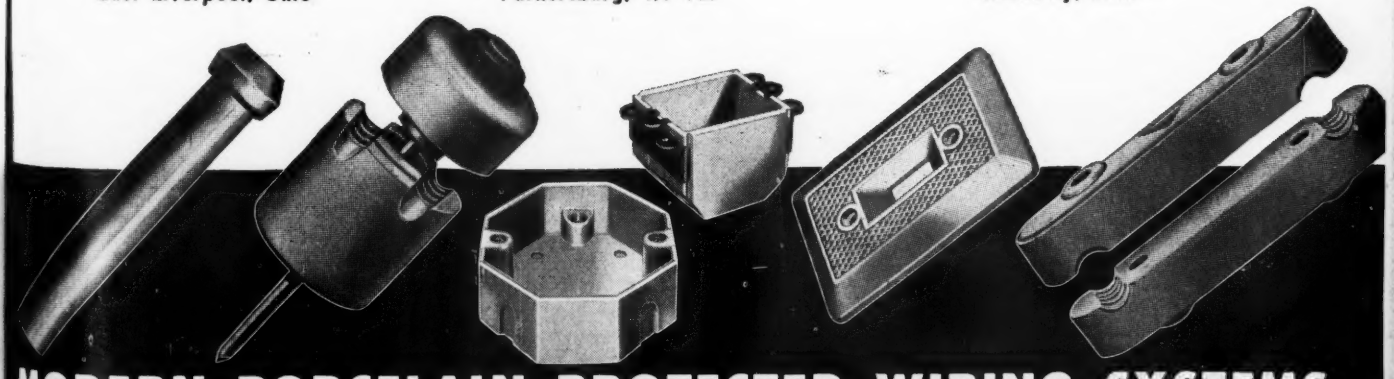


MODERN PORCELAIN PROTECTED WIRING SYSTEMS

IAEI MEETINGS

No. 14 wire, type-S fuses, a new code in 1945, the need for ordinances prohibiting the sale of unsafe electrical devices and appliances, postwar problems with reinspection, substitute materials, surplus and salvage stocks and the "90-day wonder" electricians turned out for shipyard and aircraft work, concerned the electrical inspectors and electrical contractors who attended the three recent annual meetings of the Rocky Mountain (Denver), the Utah (Salt Lake City) and the Montana (Great Falls) chapters of International Assn. of Electrical Inspectors. Although not on the program, contractors in each area attended and participated in the discussion.

Victor Tousley, secretary of IAEI, Chicago, who attended the three successive meetings, announced that a new National Electrical Code would be issued in 1945 and that all members would be sent a questionnaire on which to report their field experience with the wartime wiring material substitutes. The fall annual meetings of the IAEI Sections will devote a large part of their time to discussing proposed changes to the 1940 Code, he anticipated.

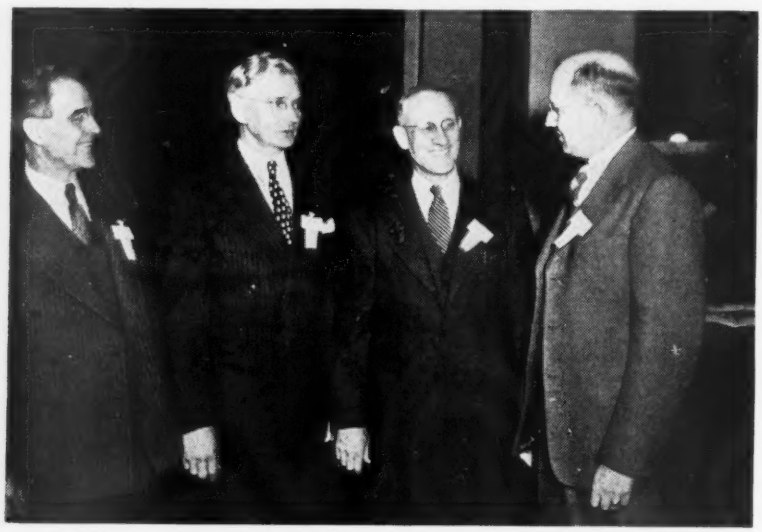
A proposal that No. 14 wire be eliminated from use in residential branch circuits and that a No. 12 wire circuit, fused at 20 amp. be established as a minimum in the Code, was discussed. The idea was taken for granted without discussion except when the fuse question was discussed in a Code forum at the Montana meeting. That group was strong for re-establishing the tamper-resisting or Type-S fuse as mandatory again. It also passed three to one the resolution to render obsolete No. 14 wire.

Also coming in for discussion was the 150-volts-to-ground limitation in the Code in view of proposed higher voltage lighting equipment. H. G. Knoderer, General Electric Co., Bridgeport engineer and Lester Johnson, G-E Co., Salt Lake City, quizzed the inspectors as to their opinions on some of the proposed changes to Articles 210 and 220, Branch Circuits and Feeders, respectively. Argued was whether the common neutral for more than two branch circuits should be placed back in the Code. Contractor argument questioned the practicability of the theoretically sound idea, and inspectors questioned the ability of the inspector in the field properly to see that the neutral was made successively large enough to carry the possible breakdown load.

J. Vernon Sharp, Salt Lake City electrical contractor, addressed the Utah chapter meeting, declaring both inspectors and government agencies cooperative if the contractor takes the time to discuss his needs with them. Recently returned from a trip to Mexico he contrasted conditions there where no effort is made to control prices or materials with the conditions in the United States.

All three of the meetings were addressed by members of the industry on topics ranging from postwar electrical opportunities to sales control, insulations for wire, housing, and Underwriters Laboratories. Presiding at the three respective meetings were: Charles Farrah, chief inspector, Denver; Reuben Baxter, inspector, Salt Lake City; John Crawford, chief inspector, Butte. Elected to succeed them were V. D. Markham, Colorado Springs; D. J. Wolters, chief inspector, Salt Lake City; Bruce Shavere, REA inspector, Lewistown, Montana.

***ROCHESTERITES** at N.C.E.I. War Conference, contractor Emil Neitz (left) and electrical inspector Paul Plantz typify the cooperative spirit of the local electrical industry groups.*



***UTAH INSPECTORS** have had as their officers, left to right, Reuben E. Baxter, electrical inspector, Salt Lake City, as chairman, Utah Chapter, IAEI. He is succeeded by D. J. Wolters, chief inspector, Salt Lake City, who was vice-chairman last term. C. F. Grant, Utah Power & Light Co., was reelected secretary-treasurer, Lester Johnson, General Electric Co., had charge of arrangements for the recent annual chapter meeting in Salt Lake City.*

E.E.I. SEES LARGE RURAL ELECTRIC MARKET

A deep-rooted interest in the future possibilities of the rural electrification market was in evidence at the Eleventh Annual Commercial Meeting of the Edison Electric Institute at Chicago's Edgewater Beach Hotel, April 3-5. Devoting a full day to the subject of electric farm utilization, the members made a comprehensive analysis of the market. The plans presented presage a busy future for the rural electrical contractor.

Highlighting the electrical needs of the farmer, C. H. Leatham, vice president, Monongahela West Penn Public Service Co., urged the members to keep electricity out of the "magic" stage in rural electric promotion.

P. T. Montfort, Texas A. & M., College Station, Texas, observed that low cost line building problems have been licked and that the salient problem now is to promote farm electrification. Rural wiring is not a new subject, he added, recalling that Texas A. & M. published a bulletin on adequate farm wiring and use of appliances back in 1915. We need a central agency as a clearing house for the dissemination of technical information on farm electrification development and research at the various agricultural experiment stations and schools, he concluded.

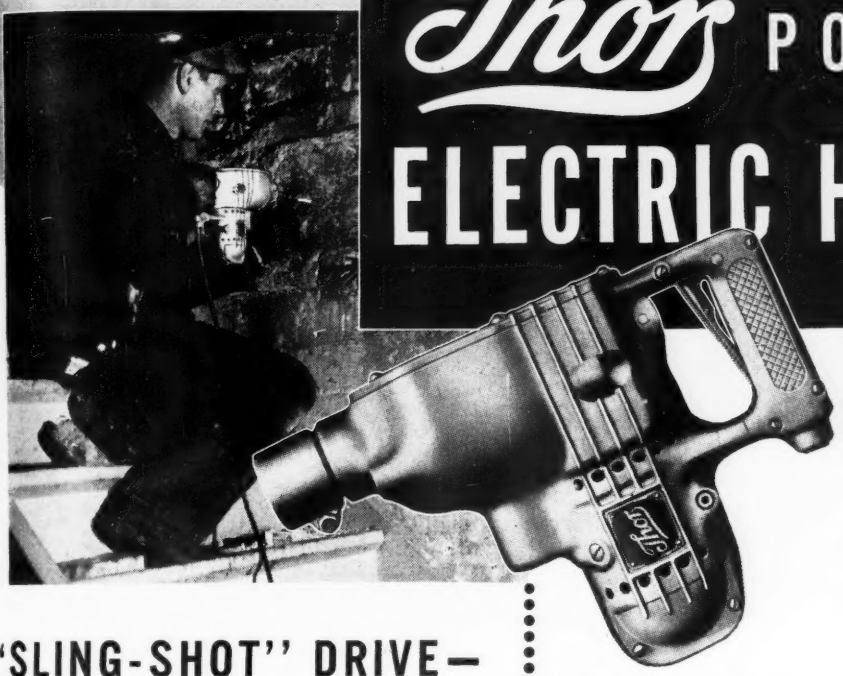
Rural electrification presents a vast development market for temperature, moisture and air control and germicidal lamps, stated A. H. Turner, International Harvester Co., Chicago, and president of the American Society of Agricultural Engineers. Reviewing the transformation of research into actual applications, Mr. Turner, urged the cooperation of allied agricultural sciences. Seeing the need for an all-over, one-shop service, his company is training their dealer station mechanics to service electrical equipment also, he revealed.

Observing that some 500,000 farms, with 10 or more cows, have no milking machines; 700,000 no milk cooling units; and 1,750,000 no water systems, Frank Watts, Farm Journal, outlined a plan to develop dealers to contact and sell the farm market electrical equipment, appliances and radio, service, installation and

STRONGER BLOWS = MORE WORK PER HOUR!

WITH THE

Thor PORTABLE ELECTRIC HAMMER



POWERFUL HAMMERING SPEEDS INSTALLATIONS ON EVERY JOB

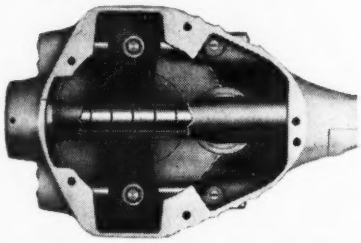
The Thor Portable Electric Hammer delivers 1,600 blows a minute—every one *a more powerful blow* than any hammer of comparable size and capacity!

For any installation work in stone, wood or metal there are hundreds of jobs of star-drilling, channeling, demolition, cleaning out mortar, web cutting, removing form marks, cutting, gouging, shaping, chipping, scaling, bushing and many more on which this powerful Thor Hammer will save you hours and dollars.

Weighing only 14 pounds, and just 13½ inches in length, it can be operated easily in any position . . . can go with the operator into the tightest, hardest-to-get-at corners.

Combined with this important handling ease are *power* features of a specially designed Thor motor that transmits power through heavy-duty, helical cut gears, and full ball bearing construction fully sealed to keep out dust and dirt that provide fast, sure hammering to get installations started.

"SLING-SHOT" DRIVE— Secret of Thor Hammer's Powerful Blow



Packs More Power into Every Blow — The Thor Hammer's radically different "Sling-Shot Drive" is a shock-proof rubber connection that drives the piston in powerful hammer action. It whips the piston back and forth 1,600 times per minute, acting as both power accumulator and shock absorber. The blow of the piston is not felt by the operator nor is it transmitted to the gears or motor.

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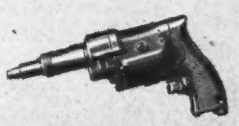
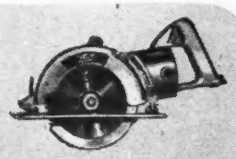
THOR ¼" PLASTIC ELECTRIC DRILL

THOR ½" ELECTRIC DRILL



THOR ELECTRIC SCREWDRIVER

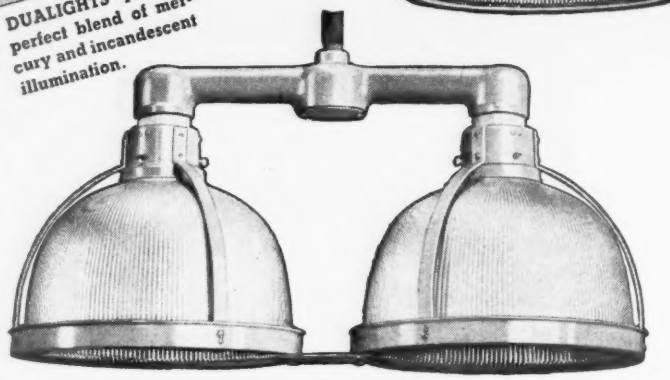


THOR ELECTRIC SAW

PITTSBURGH Permaflector INDUSTRIAL UNITS

E-530-B PERMAFLECTOR not housed.

I-1005-N with refl.ining ring.



D-530-N DUALIGHTS provide perfect blend of mercury and incandescent illumination.

Permaflector silvered-glass units provide highly efficient, engineered light control for every industrial lighting requirement . . . general or localized . . . ceiling or sidewall installation . . . high or low bay mounting . . . for medium, broad, or concentrated distribution . . . for lamp wattages of 100 to 1,500 watts . . . with incandescent, mercury vapor lamps, or a combination of both . . . mounted as single units or on dual hangers. Sold on priority thru Electrical Wholesalers.

FLOODLIGHTS

Rugged in construction · weather-proofed and corrosion-resistant · equipped with famous silver-mirrored glass Permaflectors. Available in 200 to 1,000 wattages, and broad, intermediate or concentrated light distributions. Complete. Ready to set up.

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ILLUMINATING ENGINEERS DESIGNERS & MANUFACTURERS of COMMERCIAL & INDUSTRIAL LIGHTING EQUIPMENT

• Now producing confidential lighting equipment for the Armed Forces and supplying Industrial users on priority (Commercial replacements from stock). Startling new post-war developements now in work will soon be announced.

wiring. Manufacturers must assume the responsibility of developing sales training courses to which dealers can send their salesmen, he added. The farmer must be sold on what electricity can do for him—not on cost—Mr. Watts cautioned, pointing out that a fully electrified farm home will save about 1,000 hours annually.

Addressing the farm group luncheon, Walter H. Sammis, vice president, Commonwealth & Southern Corp., New York, revealed that electric utilities are in a position to build some 40,000 miles of rural lines to serve 175,000 farms immediately materials are released. The rural electrification program needs more active cooperation between the farmer, utility and manufacturer and improved methods for selling and servicing equipment must be developed, he observed. Farm production wiring should be sold and installed first so the resultant savings can be used to electrify the homestead, he concluded.

Farm wiring must be considered on the basis of regional requirements, stated C. P. Wagner, Northern States Power Company, Minneapolis, as he outlined a farmstead wiring plan that took into consideration safety to human and animal life, adequate capacity and economy. Mr. Wagner favors the yard pole metering and distribution center system which facilitates easy revamping for increased loads and reduces long feeder runs to a minimum.

Numerous time saving features of rural electric service were mentioned during a panel session on the utilization of new farm equipment.

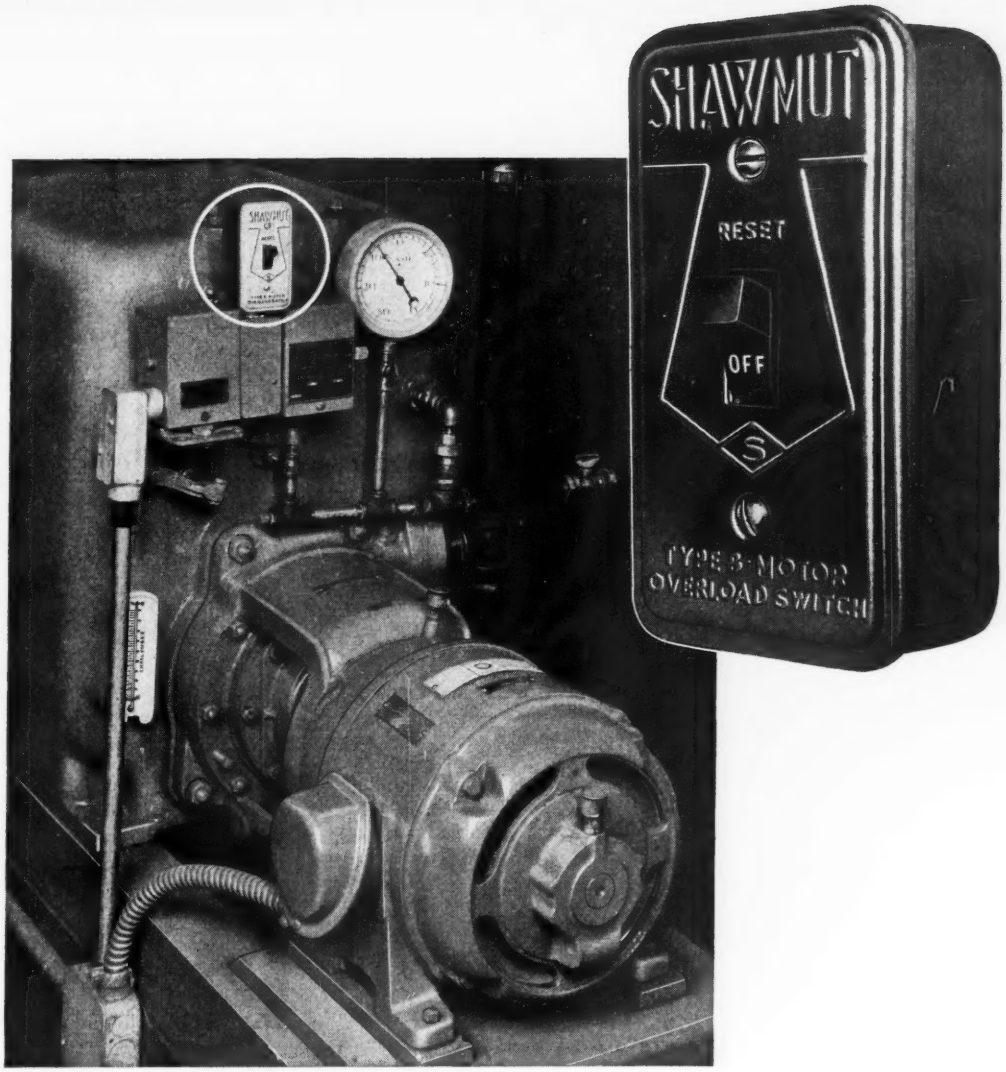
WIRING DESIGN HANDBOOK COMMITTEE REORGANIZED

An Industry Committee on the Handbook of Interior Wiring Design has been formed to bring out a revised edition to serve the postwar market.

Six editions of the Handbook had been printed before the start of the war and it has served adequately as a "wiring bible" for architects, engineers, contractors, educational institutions and others. On the Industry Committee will serve representatives of National Electrical Manufacturers Association, International Association of Electrical Inspectors, Illuminating Engineering Society, American Lighting Equipment Association, National Electrical Contractors Association and National Electrical Wholesalers Association and the Edison Electric Institute. E. A. Brand of Buffalo who was chairman of the former committee will serve as Chairman of the new committee and A. C. Bredahl of Westinghouse Electric & Mfg. Company, Pittsburgh, is secretary.

At its first meeting in New York on May 4th it was decided to expand the committee to include representatives of American Society of Agricultural Engineers and the American Institute of Electrical Engineers who are vitally concerned in postwar wiring developments. The committee unanimously approved the addition to the Handbook of a section on Farmstead Wiring.

A technical sub-committee under the



ON SMALL PUMPS

and in general on all equipment driven by fractional horse-power motors, use the SHAWMUT Type-B MOTOR SWITCH. It is exactly what you have been looking for — positive overload protection, and a simplicity and sturdiness of design and construction that ensure long and satisfactory electrical and mechanical life. Among its other advantages are its abundant wiring space and ease of installation; its rust-resistance; its freedom from flimsy wound or delicate springs. Maximum rating, single and double pole, 1 h.p., 115-230 volts A.C. Two types, open and enclosed; open type fits all standard boxes and cover plates. Exclusive patented features, other patents pending. For full information, ask for our Bulletin 406.

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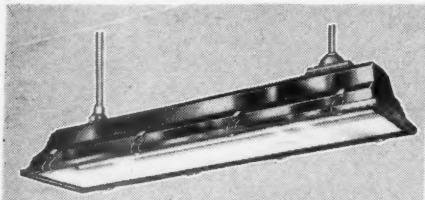
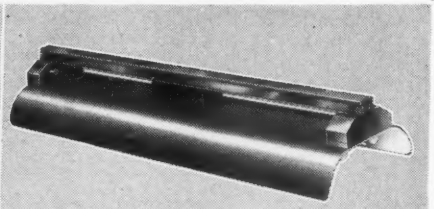
COMPLETE LINE
For Industry's Needs

FLUORESCENT
Skilled Lighting



"SERIES II" DUST-TIGHT UNIT



RLM STANDARD UNIT

Steel DUST-TIGHT Fluorescent Fixtures for Class II "Group G & F", and Class III and IV Hazardous Locations . . . High-efficiency non-metallic Fluorescent Fixtures for standard uses . . . both provide Skilled Lighting with fluorescent lamps. These fixtures are but two examples of up-to-the-minute Wheeler engineering, backed by 63 years of experience in lighting. The DUST-TIGHT unit is advantageous where lamps, sockets and reflecting surfaces must be protected from dusts and vapors. *Standard unit*, easily adapted to continuous runs, has reflection factor not less than 85%. Made in 2 and 3-lamp 48" units; 2-lamp 60" units.

INCANDESCENT
Skilled Lighting

WHEELER VAPOLUX UNIT

RLM SOLID NECK REFLECTOR

For incandescent lighting in Hazardous Locations, Wheeler has many fixtures. Among them is the Vapolux fixture, offering top efficiency in every detail. Dust-tight and vapor-proof, it is made in standard styles for 100-500 watt lamps. Highly durable and easy to install.

Wheeler RLM Solid Neck Reflectors provide maximum lighting efficiency. Made in dome, angle and all other standard types. One-piece construction gives rugged, trouble-free service indoors or out. 75 to 1500 watts.

These are a few examples of the high-efficiency light engineering — Skilled Lighting — which Wheeler had developed to give maximum visual accuracy for workers. Write for full details on the complete line of fluorescent and incandescent fixtures. **Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass.** New York, N. Y... Representatives in principal cities.

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Lighting Equipment Specialists Since 1881

Chairmanship of A. C. Bredahl will start immediately developing the sections on Residence Wiring and Farmstead Wiring.

REVISED INSTRUCTIONS FOR WPB FORM 541

Business firms and individuals who normally apply for priority assistance on WPB Form 541 (formerly PD-1A) for the acquisition of equipment or materials other than controlled materials are advised to follow revised instructions for the filing of this form, according to WPB.

The amended instructions apply to the use of the form only. No change is made in the form itself or in the information asked for.

In the interest of paper conservation, applicants are advised to continue to use the old form (identified by the printing date 7/6/43, which appears in the upper left corner), but observing the revised instructions.

The revised instructions are as follows:

Applications for Project Ratings

In line with certain exceptions permitted under Direction 2 to Conservation Order L-41 and Controlled Materials Plan Regulation 5 and 5A allowing the installation without specific authorization of minor capital additions and processing equipment or machinery, the instructions on page 4 of WPB Form 541 under the heading "Applications for Project Ratings" has been amended to read:

"Under Conservation Order L-41 authorization is required to begin any construction, including additions and installations, the cost of which is above certain dollar limits. Below these dollar limits, construction may be carried on without any specific authorization from the War Production Board. WPB Form 541 may be used to secure preference ratings on materials or equipment for construction which is below the dollar value requiring authorization under Order L-41. For all construction exceeding the dollar limits specified in Order L-41, WPB Form 617 (formerly PD-200) must be filed for authorization to begin the construction and for a preference rating and allotment of controlled materials."

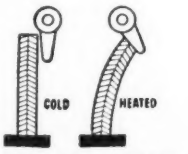
Applications for Equipment

Many WPB orders require specific authorization for the acquisition, sale or delivery of equipment to be obtained on WPB Form 1319 (formerly PD-556). The WPB Form 1319 instruction booklet (obtainable at any WPB office) lists the items released on the form, and these items should not be applied for on WPB Form 541. If a preference rating is required, it will be assigned on WPB Form 1319 and a separate application on WPB Form 541 is not required.

HOUSING UTILITIES STANDARDS AMENDED

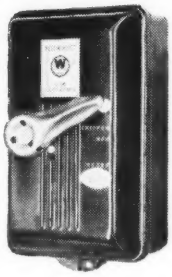
The Office of War Utilities has amended its Housing Utilities Standards, governing materials used in making electric service connections, to allow for maximum

Wild arcs tamed *Quick!*



CALLING THE TRICK is the job of this Westinghouse Bi-metal Element. Two metals which react differently to heat are bonded together. Threatening overloads cause the Bi-metal to bend, tripping the interrupting mechanism and opening the circuit—*before* any damage is done.

TAMING THE ARC is the job of the "De-ion" arc quencher. It consists of parallel metal plates in the form of a grid. The arc is drawn into the quenching chamber . . . divided into segments . . . smothered between the plates—in the space of a half cycle.



When current's on the rampage, a circuit breaker has to function *fast* and *sure*—every time!

Westinghouse "De-ion" Circuit Breakers are built for just such hair-trigger protective action. They pass harmless overloads without interruption, but let danger threaten, and quicker than a blink of the eye—the circuit's opened . . . the arc is quenched. Burns and pits are minimized; contacts stay cleaner, last longer.

Once the disturbance is cleared, service is instantly restored by a flip of the indicating handle. No waiting—no repairs—no parts to replace.

Protect equipment and circuits with Westinghouse "De-ion" Circuit Breakers. Ratings up to 600 amperes; enclosures for nearly every type of service. Call your Westinghouse Representative today. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

"DE-ION" CIRCUIT BREAKERS

KLEINS

TOOLS YOU CAN RELY ON

WHEN you read of a new Naval victory—a new Army advance—you know that Klein pliers are helping our fighting forces get their job done.

Today, the demands of war for quality tools, both on the battle-fronts abroad and on the industrial front at home, are so great that many Klein users are forced to wait until Victory before they can again secure the tools they need.

The name Klein today still stands for the highest quality in pliers, just as it has for nearly a century.

And here at Mathias Klein & Sons we are producing more of these quality tools than ever before.

When the war is won, this production will again assure you a constant supply of pliers and wrenches, grips and climbers, belts and straps—the same quality tools and equipment that have served the electrical industry "since 1857."

ASK YOUR SUPPLIER

Foreign Distributor:

International Standard Electric Corp., New York

This book on the care and safe use of tools will be sent on request.

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possible savings in the use of small transformers of 5 kva. and less capacity.

General standards have been amended to read as follows:

Primary, secondary and service facilities shall be designed so as to use the smallest feasible number of transformers and particularly to avoid the use of transformers 5 kva. and smaller wherever possible.

Maximum conductor allowances for secondary line shall be increased by 500 feet of conductor for secondary where necessary to make possible savings in the number of transformers which are required, under the most recent provision of the standards.

REPAIR MEN URGED TO CONSULT LOCAL WPB OFFICES

The War Production Board has warned that repairmen who use Direction 2 of Controlled Materials Regulation 9-A for the purchase of $25 worth of materials for the installation of cooking, plumbing, heating or used air conditioning or refrigerating equipment must not use such material in violation of other WPB orders.

It was pointed out that limitation orders governing various materials, such as M-9-c-4 governing copper, still contain prohibitions against certain uses. Repairmen operating under CMP Reg. 9-A were urged to consult local WPB offices for rulings on prohibited uses. Jobbers are also governed by prohibitions of other orders in making sales under CMP 9-A.

WIRE AND CABLE IAC ORGANIZED

First meeting of the newly-organized Technical Copper Wire and Cable Industry Advisory Committee was held May 1, according to the WPB. E. H. Hammond, Jr., is government presiding officer.

Committee members include:

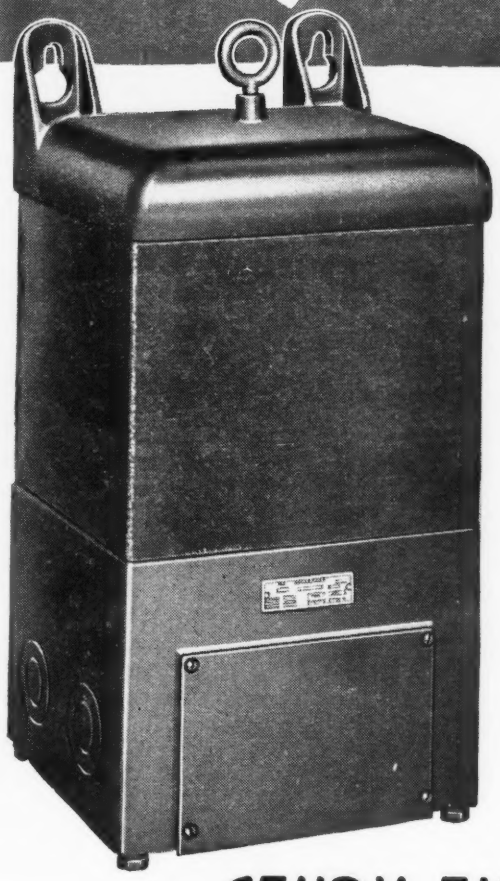
Alfred Bellis, John A. Roebling's Sons Co., Trenton; M. R. Cottrill, General Insulated Wire Works, Inc., Providence; A. D. Cummings, Collyer Insulated Wire Co., Pawtucket; Ernest W. Davis, Simplex Wire & Cable Co., Cambridge, Mass.; Frank E. Dresner, General Motors Corp., Warren, O.

I. J. Furst, Circle Wire & Cable Corp., Maspeth, L. I.; Clifford O. Hull, General Electric Co., Bridgeport; John H. Ingmanson, The Witney Blake Co., New Haven; R. W. Moore, National Electric Products Corp., New York; W. F. Osler, Jr., Cornish Wire Company, Inc., New York.

W. T. Peirce, American Steel and Wire Co., Worcester; Glenn E. Rolston, Rome Cable Corp., Rome, N. Y.; Samuel J. Rosch, Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.; R. A. Schatzel, General Cable Corp., Bayonne; Daniel Seifer, Diamond Wire and Cable Co., Chicago Heights, Ill.

Robert L. Simpkins, Essex Wire Corp.,

It's to YOUR Advantage



to use

Wagner

Air-Cooled TRANSFORMERS

Because they are–

Safe for either indoor or outdoor installation.

Compact and easy to install.

Usable right at load.

STUDY THESE FEATURES:

1. Dry-type . . . no liquid.

2. Core and coils are vacuum treated in compound for protection against moisture.

3. Totally enclosed.

4. Provided with built-in junction box with knockouts on sides and bottom for conduit or open wiring.

5. Large removable coverplate of junction box assures ease in making connections.

6. Hanger-lugs designed for ease in mounting.

7. All ratings within the limits of the National Board of Fire Underwriters have the Underwriters' approval.

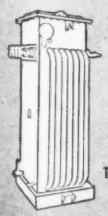
Write FOR COMPLETE LITERATURE

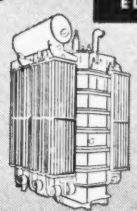
Wagner

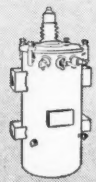
ELECTRIC CORPORATION
6413 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

T44-10

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING


NOFLAMOL TRANSFORMERS


POWER TRANSFORMERS


RURAL-LINE TRANSFORMERS

DISTRIBUTION TRANSFORMERS

FLAMENOL* BUILDING WIRE (Small Diameter)
MEETS ALL REQUIREMENTS

Type SNW
For Wet Locations

Type SN
For Dry Locations

Now you can wire buildings completely with thermo-plastic insulated Flamenol Small Diameter Building Wire. Use Type SN for dry locations and the new Type SNW for wet locations.

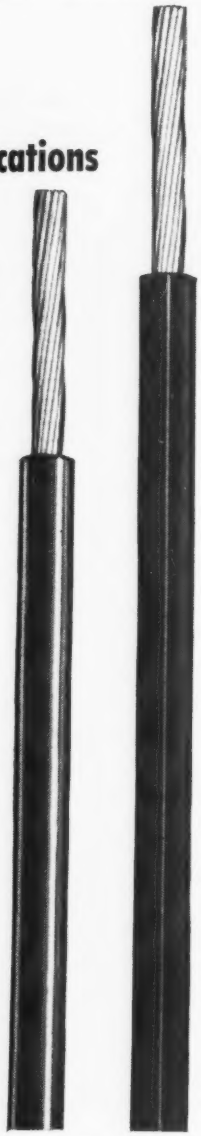
The insulation of both these wires has long life, is high in dielectric and mechanical strength and is resistant to oils, acids and alkalies. In addition, Type SNW Flamenol Wire insulation has low moisture absorption. This wire is approved by the Underwriters' in sizes 14 to 4/0 inclusive for use in raceways in wet locations as follows:

1. *Underground*
2. *In concrete slabs or masonry in direct contact with the earth*
3. *In wet locations*
4. *Where the condensation and accumulation of moisture within the raceway is likely to occur.*

Both Types SNW and SN Flamenol Building Wires are small in diameter and easy to install. For further information see the nearest distributor or mail the coupon for descriptive folders.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news, every weekday 6:45 P.M. EWT, CBS.

*Reg. U.S. Pat. Off.



Both Types SN and SNW Flamenol Building Wire are ideal for maintenance wiring, rewiring and new wiring.

BUY WAR BONDS

General Electric Company
Section W-641-8
Appliance and Merchandise Dept.
Bridgeport, Connecticut

Sirs: Please send me the folders on Type SNW and Type SN Flamenol Small Diameter Building Wire.

Name.....

Address.....

City..... State.....

GENERAL ELECTRIC

Detroit; E. G. Sturdevant, U. S. Rubber Company, Bristol, R. I.; H. H. Wermine, Belden Manufacturing Company, Chicago; F. H. Wetzel, The Electric Auto-Lite Co., Port Huron, Mich., and Edward D. Youmans, The Okonite Company, Passaic.

ELECTRICAL EQUIPMENT DEALERS OFFER AID

Representatives of electrical equipment dealers told WPB recently that dealers represent a normal trade channel which can be used to advantage in disposing government surplus electrical equipment.

Members of the Electrical Equipment Dealers Industry Advisory Committee suggested that dealers have storage facilities and the ability to recondition equipment, both of which would aid any government disposal program. They would be able to guarantee performance of reconditioned equipment which the government, without reconditioning facilities, would be unable to do, committee members added. They asked that WPB make the committee's position clear to the surplus War Property Administration.

Also sought was the aid of the Office of Price Administration in connection with price boosts aimed at facilitating operations of equipment dealers and the aid of War Manpower Commission in continuing the present status of electric motor repairmen as essential workers.

MIDWEST POWER CONFERENCE REVIEWS ELECTRICAL ADVANCES

The latest advances made in the development of electrical equipment were presented at the electrical sessions of the Midwest Power Conference at Chicago's Palmer House, April 13-14. Subjects of interest to electrical contractors and maintenance men included developments in the field of control; modern transformer developments, deterioration of insulation in oil immersed transformers; new applications of mercury arc rectifiers and electrical plant maintenance.

The industrial control branches of the electrical industry have reaped the benefits of a concentrated application of wartime efforts, stated E. H. Alexander, engineer, industrial control division, General Electric Co., Schenectady, N. Y., as he reviewed the engineering advances made in development of electrical control apparatus for application on shipboard, aircraft, tanks, industries and the new phases of electronic control. Research on contact tip materials as well as expansion materials will lead the way to better control apparatus with superior overload devices in the future, he predicted. Presaging a bright future for electronic controls, he cited its present application to resistance welding in industry.

Summing up his paper on new applications of mercury arc power rectifiers, W. E. Gutzwiller, engineer in charge of rectifier application, Allis-Chalmers Mfg. Co.,

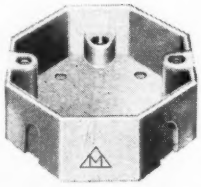
MEET THE DEMAND WITH ILLINOIS

COMPLETELY INSULATED ALL PORCELAIN WIRING SYSTEMS . . .

PORCELAIN CONFORMS TO THE NATIONAL ELECTRICAL CODE

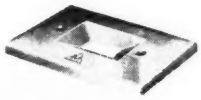
TOGGLE SWITCH PLATE

Look for this Trade Mark



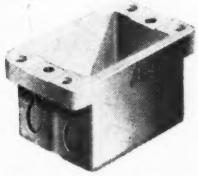
STANDARD KNOBS

STANDARD TUBES



SWITCH BOXES AND COVERS

OUTLET BOXES AND COVERS



DUPLEX RECEPTACLE COVER

CLEATS

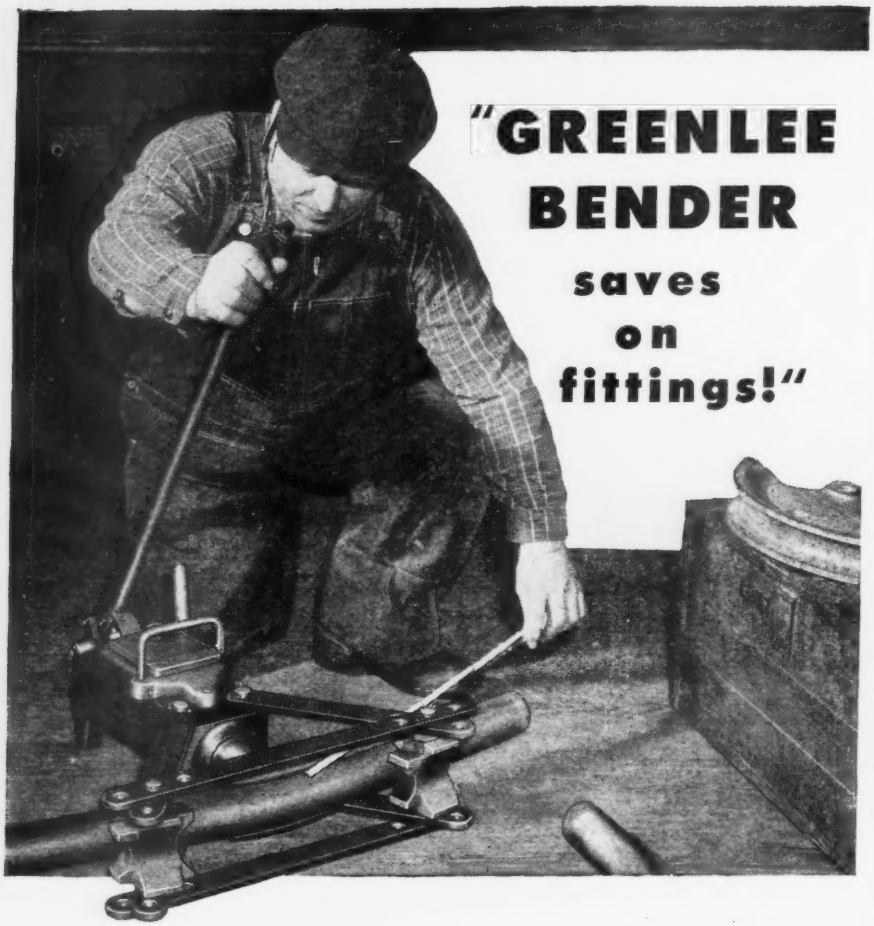
★ Contractors everywhere know that Porcelain in large quantities is available —that, therefore, they can do wiring jobs today with no let down in wiring quality —that they still can assure customers of permanency, dependability, and economy—that simplified modern installations are the result of the use of All Porcelain Wiring Systems.

This all means continued business for you — wiring goes right along — porcelain products are in demand. So, as those calls come to you for porcelain, be sure you are prepared with ILLINOIS PORCELAIN.

No vital materials go into the production of porcelain, materials do go into porcelain that make these systems durable— that are not affected by rust or corrosion — that make possible full safety — that make these systems valuable where there is dampness and fire hazard.

Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts. They can be installed without grounding.

Illinois ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS



PORTABLE CABLE PULLER

Designed to replace cumbersome, heavy equipment and to eliminate electricians' difficulties in proper anchorage, GREENLEE Cable Puller exerts 7500 lb. maximum pull, has 2 speeds through direct and back gears.

Shear pin in back-gear shaft prevents damage under excessive pull; dog on back gear prevents cable unwinding in case of pin shearing.

Clamping device fastens direct to conduit through which cable is to be pulled ...allows pulling in line with conduit, prevents loosening of hangers.

OTHER TIME-SAVING TOOLS FOR ELECTRICAL WORK:

HAND BENDERS
JOIST BORERS
KNOCKOUT TOOLS
PIPE PUSHERS
RADIO CHASSIS PUNCHES

"We save on fittings and manufactured bends by using our GREENLEE Bender", states C. N. Dennison, owner of the Denny Electric Co., Cleveland, Ohio. "Our men insist on the GREENLEE Bender being sent on the job because it's *fast* and easy to operate—saves us 25 to 50% labor hours, cuts material spoilage. And there's no maintenance cost!"

A tool which cuts cost and saves time earns the respect of busy electrical contractors like Mr. Dennison . . . pays heavy returns on the original investment! His GREENLEE has been in constant use for over three years.

Compact, portable . . . the GREENLEE Bender produces smooth, perfect bends right "on the spot" . . . does not kink or damage the conduit. Get all the facts on how to do any bending job better . . . faster . . . easier. Send for Catalog 33E on GREENLEE Benders and other special tools for saving manpower on electrical work. Greenlee Tool Co., 1746 Columbia Avenue, Rockford, Ill.

Get Ready with Greenlee!

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

Milwaukee, predicted that electronic power devices will have a strong influence on the electric power industry in the postwar period. He envisions flexible non-synchronous system ties combined with long distance d.c. transmission, electronic high speed switching, electronic speed control of commutatorless motors, and the application of electronic high frequency power for heat treatment of metals.

Outlining modern transformer developments and economic trends, J. K. Hodnette, engineering manager, transformer division, Westinghouse Electric and Manufacturing Co., Sharon, Pa., pointed out that modern transformers permit lower operating costs, investment, maintenance, and losses. Attributing a strong trend to 3-phase units during the war—two-thirds of all units now 3-phase compared with 15 percent previously—to reduced first cost and smaller size due to new insulating techniques, he went on to describe a one-fourth to one-third increase in capacity provided by forced air auxiliary cooling. The trend to higher distribution voltages emphasizes need for higher reliability of equipment, he concluded.

Discussing the deterioration of insulation in oil immersed transformers, Prof. F. J. Vogel, Illinois Institute of Technology, concluded that the effects of oxidation and other chemical reactions are water condensation, acidity and high power factor. Newer transformers which prevent oil oxidation and use inert materials should have longer life, require much less maintenance and stand higher operating temperatures. With the older units, maintenance and use of judgment would seem to be the only way to prevent troubles from these sources, he added.

A five-point postwar utility program, that incidentally also would benefit the contractors, was urged by Lieutenant Commander J. A. Krug, former Director, Office of War Utilities. Speaking at the All Engineers Dinner at the Conference, Commander Krug asked the utility industry to study industrial facilities in their areas and find some practical use for them; study the mass distribution of low cost appliances; promote the application of reverse cycle refrigeration in the home heating field; organize a cooperative plan to determine the most practical uses of power in industry; and perfect plans for the extension of farm electrification.

PCEA HOLDS SPRING CONFERENCE

Three approaches to the wiring problem are being made by the Pacific Coast Electrical Assn., according to the reports made at both the northern and southern California spring conferences of that all-industry organization. H. C. Rice, Southern California Edison Co., chairman, and Jarad Hill, Pacific Gas and Electric Co., vice-chairman made the respective reports. First a concerted move, suggested by electrical inspectors, is being initiated to have 20-amp, branch circuits and No. 12 wire established for residential wiring as minimums. The Electrical Committee of NFPA has been addressed

Score another war production bull's eye for ***FRINK:***

ENGINE COWLINGS for the cannon-carrying P-39

Pumping powerful armor-piercing shells into enemy tanks and blasting his gun emplacements with explosive cannon fire, the low-flying P-39 is always a welcome sight to our ground forces. On fighting fronts all over the world our troops and the troops of our allies cheer when they see these fast, sleek planes swoop down to clear the way for their advance.

The engine on a P-39 is covered with a cowling, snugly fitted to conform to the shapely streamlined surface of the ship's fuselage. Many of these engine cowlings are made by Frink.

During the 87 years that The Frink Corporation has been specializing in precision engineering and manufacturing, the name Frink has become synonymous with quality and skill in the lighting industry.

A pioneer in Fluorescent illumination as well as in Incandescent lighting, The Frink Corporation developed LINOLITE, the famous "engineered for vision" Fluorescent equipment now giving such profitable and trouble-free service in many of America's foremost factories, stores and banks.

Today Frink is heavily engaged in war production. Tomorrow Frink will resume engineering and manufacturing the high-quality lighting equipment that has gained such an enviable reputation in the industry.

LIGHTING SINCE 1857

THE FRINK CORPORATION
BRIDGE PLAZA NORTH
LONG ISLAND CITY 1, N.Y.

Subsidiaries: Sterling Bronze Company, Inc.
Barkon-Frink Tube Lighting Corporation

★ ★ ★ ***All Frink employees invest at least 10% of their earnings in War Bonds.*** ★ ★ ★
WE ARE PROUD OF THAT RECORD. LET'S ALL BUY WAR BONDS!

Dependable Protection

MONARCH FUSE COMPANY, LTD.

116 E. FIRST STREET JAMESTOWN, N. Y.

with such a proposal and support of it solicited from all parts of the country. Second, a simple wiring allowance estimate chart is in preparation to be used by loaning agencies in approval and earmarking of home building loans to provide sufficient money for an adequate wiring system. Third approach is through energetic participation in Home Planning Institutes, conducted by the adult education branch of the California school system in cooperation with all branches of the building industry. Ten or 12 class, 2 hours each, courses in home planning have been given in 11 cities in the southern part of California and will be given in about 20 more this fall. The PCEA presents the wiring, lighting and kitchen planning lessons for each course.

RECORD ATTENDANCE AT C.T.S.C. CLINIC

Past attendance records were shattered when 4,000 enthusiastic and interested engineers, scientists and manufacturers gathered at Chicago's Hotel Stevens, March 30, for the Second Chicago War Production and related problems Conference. Sponsored by the Chicago Technical Societies Council, an affiliation of scientific, technical and engineering societies in Metropolitan Chicago, in cooperation with the U. S. Army, U. S. Navy and War Production Board, the conference was designed to provide a means for the exchange of mutually beneficial ideas to expedite the war effort on the production front.

Under the sponsorship of the Illuminating Engineering Society, the panel session on illumination covered the subject of Lighting in Industry. L. V. James, lighting specialist, General Electric Co., Chicago, discussed the importance of lighting to aid the seeing task of the older eyes in industry today. Better working conditions under good lighting fosters better labor relations in industry —all resulting in more efficient production, pointed out I. L. Illing, chief illuminating engineer, Wisconsin Electric Power Company, Milwaukee. Systematic maintenance of the lighting system to attain highest illumination efficiency was outlined by John Harrington, illuminating engineer, Commonwealth Edison Company, Chicago. Carl W. Zersen, manager, Chicago Lighting Institute, was the panel chairman.

NFPA ANNOUNCES PLANS FOR 1945 EDITION OF CODE

The long discussed revision of the National Electrical Code, to cover the rapid advances made in the development and application of electrical equipment during the war period, will become an actuality in 1945 according to a recent announcement of the National Fire Protection Association.

Bulletin No. 44-2 from Alvah Small, chairman, Electrical Committee, to mem-

YOU CAN'T AFFORD TO SHADOWBOX WITH THE PAPER-BOX PROBLEM!

NO, SIR. Or with any other angle of the paper conservation problem. Our boys need every bit of paper and paper board the Army can get to ship their precious invasion supplies in. And it's up to you and every other manufacturer to cut and cut and cut again on the use of paper and paper board.

For every time a convoy sets sail—that's so much more paper and paper board in action. And the supply, as you know, is diminishing.

So your job is to figure every known way, yes, and a few unknown ways, to USE LESS PAPER AND PAPER BOARD.

Don't worry about the public, your public, squawking about your cutting down. The big all-out national drive right now is selling the public on the necessity for paper conservation. They'll be with you.

The green light is yours. Step on it.

If your company and your community have not already started Paper Conservation Committees, why not get them started now yourself?

USE LESS PAPER BECAUSE

Paper vests have proved excellent for aviators and ground crews as cold protection.

Paper is used for disposable gun covers and ordnance wraps to protect such equipment while making invasion landings.

The Army supplies helmets of laminated fiber for non-combat duty in the tropics.

Many essential airplane parts are fabricated of plastic with a paper base.

Army trucks require 20 pounds of paper for safe delivery.

It takes 25 tons of blueprint paper to make a battleship.

USE LESS PAPER THESE WAYS

Review all printed forms periodically for essentiality; consolidation; elimination of waste space; standardization of sizes, weights, color, grade; elimination of color where possible.

Eliminate carton insert and/or directions when possible and substitute information on label.

Overhanging, extended or padded carton tops should be eliminated unless they can be justified in a critical paper shortage.

Use and re-use carbon paper consistently.

Consider the possibility of reducing the length and increasing the diameter of tubular products as a means of conserving folding and set-up boxes.

Let's All Use Less Paper

This advertisement prepared under the auspices of the War Advertising Council in co-operation with the Office of War Information and the War Production Board.

Space for this advertisement contributed by ELECTRICAL CONTRACTING

ELECTRICITY
For Any Job—Anywhere

For a dependable source of electricity on projects remote from commercial power, Onan Electric Plants are proven leaders in the field. More than half of the Armed Forces' total requirements for Power Plants are built by Onan.

Gasoline driven . . . single-unit, compact design . . . Sturdy construction . . . Suitable for mobile, stationary or emergency service.

Over 65 models, ranging in sizes from 350 to 35,000 watts. 50 to 800 cycles, 110 to 660 volts, A.C.—6 to 4000 volts, D.C.—Also dual A.C.-D.C. output types.

Descriptive literature sent promptly on request.

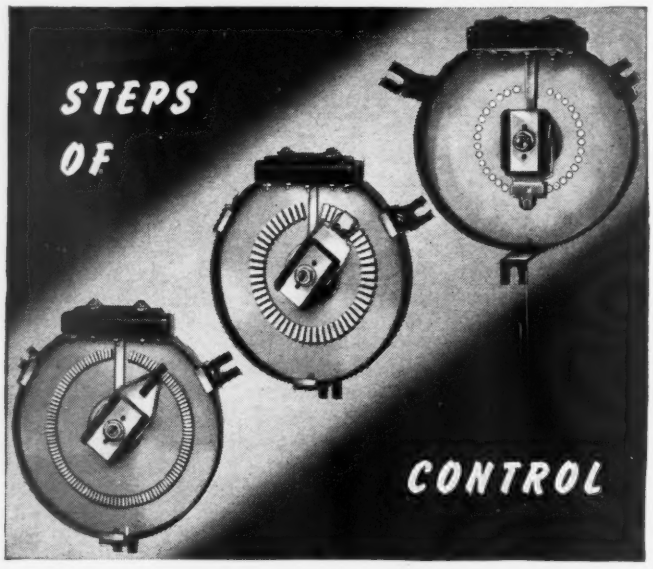
D. W. ONAN & SONS

2090 Royalston Ave.

Minneapolis 5,

Minnesota

ONAN
ELECTRIC PLANTS



Wide selection in the number of steps of control is provided in Ward Leonard Plate Type Rheostats. This often saves going to multi-plate assemblies. Ward Leonard Plate Type Rheostats are made in six sizes: 4", 6", 8", 13", 15½", and 18" . . . single and multi-plate . . . front and back-of-board mounting . . . manual and motor driven. You can get exactly the rheostat you want from Ward Leonard. Send for Rheostat Bulletin.

ARMY E NAVY

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC CO. • 28 South St., Mount Vernon, New York

bers and alternates, Electrical Committee, NFPA, and co-operating bodies announced the procedure (determined by a special subcommittee of the Emergency Committee) for the preparation of the 1945 Edition, N.E.C., and the following stop dates:

Proposals for Code Changes—final date, Sept. 30, 1944—Any proposal for change in the 1940 Edition of the National Electrical Code originating outside of Article Committees, special committees, or subcommittees of the Electrical Committee must be submitted in writing to the chairman of the Electrical Committee not later than the above date.

Article and Subcommittee Reports—final date, December 15, 1944—Chairmen and members of Article Committees and of technical subcommittees are to submit their reports to the chairman, Electrical Committee, on or before the above date.

Publication of Article Committees Reports—February 1, 1945—A bulletin containing reports of the Article Committees and any previous Interim Amendments will be published on or about Feb. 1, 1945. Minority reports of Article Committees, if any, filed in time with the chairman, Electrical Committee, will be included.

Electrical Committee Meeting—The meeting of the Electrical Committee will be held in Chicago during either the week of May 14 or May 21, 1945. A formal notice of this meeting will be issued early in April, 1945.

Distribution of New Code—Indications are that the revised edition of the N.E.C. will be distributed late in 1945.

NISA MEMBERS WIN IDEA AWARDS

There is a pot of gold at the end of the idea rainbow for members of the National Industrial Service Association. Shop men who submitted entries to the award committee were paid off in cold cash when the final choice was made at the recent Cincinnati NISA Conference.

Of a total of twelve entries submitted last year, three were in the running for top honors. The recent NISA Bulletin announced the following winners:

SPECIALISTS in farm wiring are (L. to R.) R. B. Briesemeister, electrician and F. C. Baumann, manager of Weise & Kuhlmann, electrical contractors of Lester Prairie, Minn.

Sound the Alert!

MANAGEMENT • LABOR

—for the 5th War Loan drive during June and July. The need for the 5th War Loan is immediate, crucial. For impending events may make the 5th the supreme financial effort of the war.

The U. S. Treasury has set the overall goal at $16,000,000,000 — $6,000,000,000 from individuals alone. This is the biggest sum ever asked of the American people—*and it must be raised.*

That's why the U. S. Treasury asks Management and Labor to sit down together and organize—NOW!

For organization—good organization—has been responsible for the excellent showing of the payroll market. And its most important single superiority has been personal solicitation—desk to desk, bench to bench, machine to machine personal solicitation. 71% of all persons on payroll deductions were solicited for the 4th War Loan.

Now, to personal solicitation, add the sales incentive of a definitely established plant quota. Build your campaign around a quota plan. Set up departmental goals. Stress percentage of participation figures. Stimulate group enthusiasm.

In planning your quota campaign, work in close cooperation with the Chairman of your War Finance Committee. Everything is set to make the 5th War Loan drive a huge success—with your help!

(Note: You've read this message. If it doesn't apply to you please see that it reaches the *one* person who can put it in action!)

Here's the Quota Plan:

1. Plant quotas are to be established on the basis of an average $100 *cash* (not maturity value) purchase per employee.
2. Regular Payroll Savings deductions made during the drive accounting period will be credited toward the plant quota.
3. 90% of the employees are expected to contribute toward raising the cash quota by buying extra 5th War Loan Bonds: 1—Outright by cash. 2—By extra installment deductions. 3—By extra installment deductions plus cash.

Example: **JOHN DOE Mfg. Co.** — 1,000 Employees

1,000 employees x $100 Regular Payroll deductions during the eight weekly payroll Accounting Periods of June and July = $100,000 Cash Quota

30,000

$70,000 (to be raised by sales of extra Bonds to at least 900 employees)

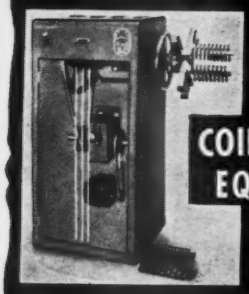
ORGANIZE • SOLICIT • DELIVER

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL CONTRACTING

★ ★ *This is an official U. S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council.* ★ ★

A Smooth WIND-UP!



with IDEAL COIL WINDING EQUIPMENT

FASTER NEATER

Coil Winder Drive

Assures uniformly wound, perfect coils. Speed is infinitely variable from 90 to 500 RPM. Automatic Counter accurately shows number of turns. Output torque 350 to 60 inch lbs. depending upon speed.

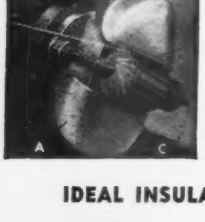
For Use With

Various Types of Coils And Armatures

IDEAL COIL WINDER HEADS

"Universal" Model, flexible — winds perfect coils ranging in size from 3⅛" x 6½" up to 13 x 16½". Winds up to eight coils from one wire—no soldering.

IDEAL ARMATURE WINDING HEAD



Adjustable to accommodate armatures up to 3" in diameter with 2¼" maximum armature stack. Easy to set up.

IDEAL INSULATION TESTER

Quickly indicates the presence of "shorts", "grounds" or broken wires in low voltage equipment, such as motors, transformers, etc.

Write For Detailed Information

Sales Offices in all Principal Cities

In Canada: Irving Smith Ltd., Montreal, Quebec.

IDEAL Sycamore

IDEAL COMMUTATOR DRESSER CO.

1041 Park Ave. Sycamore, Ill.

M. E. Assalone, Tennessee Electric Motor Service, Nashville, Tennessee was awarded the first prize of $150. His entry was a table with a sliding index for use in setting, instantly and without previous trial, the adjustable winding head of a Potter and Rayfield winding machine.

The second prize of $100 was awarded to C. W. Bedoit of the Chattanooga Armature Works, Chattanooga, Tennessee. His entry was a setup for a motor testing switchboard.

Giles Armature & Electric Works, Marion, Illinois, won the third and final prize of $50. This entry was a design of a tension device for use with armature banding wire.

Despite the fact that there were only twelve entries submitted from a total membership of more than 600, the Board of Directors decided to continue the award contest for another year. The same prizes and same rules will apply. The present Awards Committee composed of S. U. Steffner, Chattanooga Armature Works, chairman; R. A. Scherer, Scherer Electric Co.; and J. Arthur Turner, Tampa Armature Works will continue its activities for another year.

The committee is confident that more interest will be shown in this contest during the present year and that NISA members will take this opportunity of exchanging labor saving ideas with other members and at the same time receive cash awards for their efforts.

AIRCRAFT ELECTRICAL COUNCIL ORGANIZED BY NEMA

The National Electrical Manufacturers Association has formed the Aircraft Electrical Council, to make the experience and the facilities of the electrical manufacturing industry more readily available to the aircraft industry.

N. J. MacDonald, vice-president of The Thomas & Betts Co., was elected chairman of the Council at a business meeting held in Chicago on April 26 in connection with the NEMA Spring Meeting.

Assisting Mr. MacDonald in his direction of the activities of the Council will be H. W. Clough, Belden Manufacturing Co., vice-chairman; and W. H. Eldridge, The Holtzer-Cabot Electric Co., vice-chairman.

NATIONAL ELECTRONICS CONFERENCE TO BE HELD IN CHICAGO

The first annual National Electronics Conference—a national forum for electronic developments and their engineering applications—will be held at the Medinah Club, Chicago, Ill., October 5-7, 1944.

The conference, sponsored jointly by the Illinois Institute of Technology, Northwestern University, and the Chicago Sections of the Institute of Radio Engineers and the American Institute of Electrical Engineers, is designed to fulfill the need for providing a common meeting place and discussion forum for technical personnel interested in the applications in the broad field of electronics.

Special emphasis will be placed on the engineering aspects of electronics with technical papers and discussion groups being planned to treat the communication, industrial, measurement, instrumentation, control, scientific and medical applications of electronics. As one means of furthering the war effort, particular attention is being given to meet the needs of many industrial engineers who have used electronic methods in rather restricted and specialized applications.

F.L.A. APPOINTS TECHNICAL DIRECTOR

The Fluorescent Lighting Association has announced the appointment of Joseph M. Smith, engineer in the cold-cathode fluorescent lighting field, to the newly created post of technical director of the Association composed of firms interested in the standardization and promotion of cold cathode electric illumination.

Mr. Smith is now surveying cold-cathode products and installations, supervising various tests and checks, coordinating the standards activities, and preparing technical data for members.

OFFICERS ELECTED FOR COMING YEAR

Peter J. Quermback has been elected president of the Electrical Contractors' Association of the Niagara Frontier for

W. M. SMITH, W. M. Smith Electric Co., Dallas, Texas motor service shop, believes in clearly identifying stock motors for his own and customers' convenience. So he has the hp., voltage, and rpm. clearly painted on the frame of every motor on the floor.

GUS MANCUSO, mainstay of the New York Giants catching staff, was also on the receiving end at Maritime Electric, Inc., Houston, Texas. His job was to purchase and expedite materials for Maritime's ship repair crews in the Galveston shipyards.

the coming year. Other officers are—vice-president, Harold E. Hoffman; secretary, Benjamin Madonia; treasurer, Frank J. Schumm, and directors, Albert J. Wolf, Otto W. Seitz, Joseph J. Zablothy and John J. Dolan.

CLAIR O. DEAN HEADS BUFFALO ENGINEERING GROUP

Clair O. Dean, sales engineer for the Buffalo Electric Co., Inc., electrical contractors, was chosen president of the Engineering Society of Buffalo at its recent annual meeting held at the Hotel Statler in Buffalo.

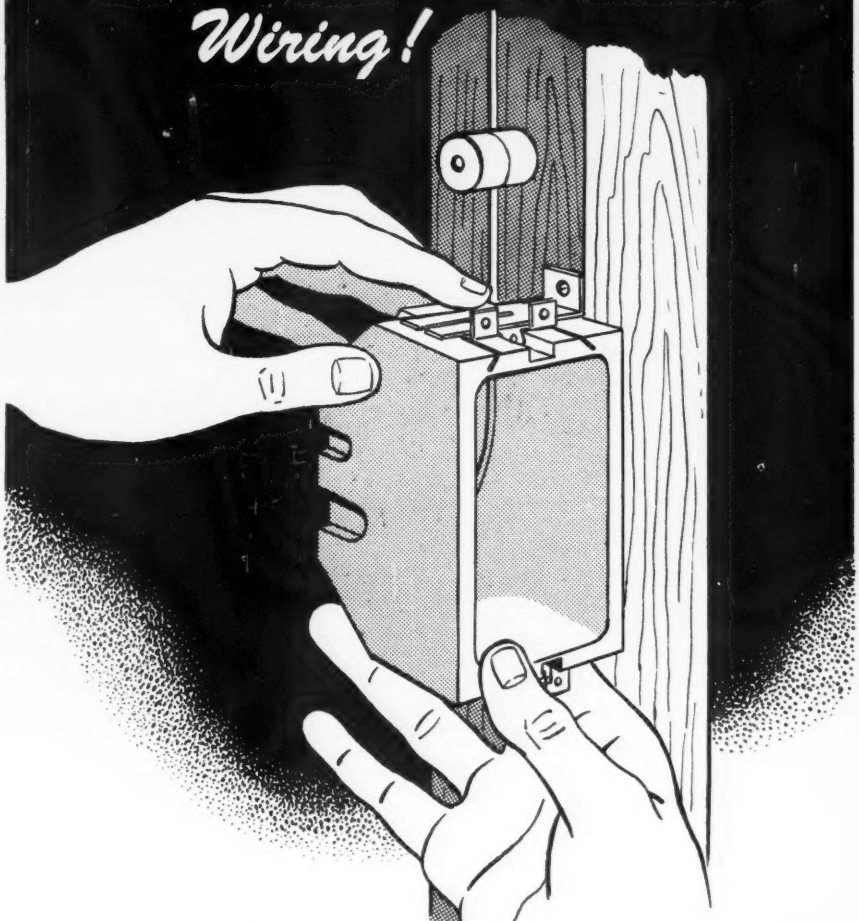
Other officers elected were Kenneth K. Koontz, Iroquois Gas Corp., vice president; Bert F. Wertman, Bison Shipbuilding Corp., treasurer; William G. Walker, George W. Walker & Sons. Inc., secretary; Robert J. Woods, Bell Aircraft Corp., director for a year; and George R. King, Buffalo Tank Corp., and Jack H. Mason, Universal Metal Welding Co., directors for two years. The new directors re-appointed Mrs. Margaret Dewyr as executive secretary.

MILWAUKEE ORGANIZES PLAN YOUR HOME CLUB

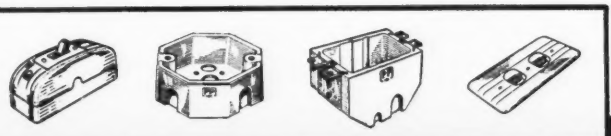
Active interest in postwar home building in the Milwaukee area was evidenced when approximately 600 enrolled in the Plan Your Home Club at its organization meeting in March. The roster is gradually approaching the 1,000 mark.

Designed to offer educational information to those interested in building or

SIMPLEST INSTALLATION *with Porcelain Protected Wiring!*



● This war has driven home an important lesson about wiring—the *simplest* way is the *best* way! This means that wiring without "frills"—by using Porcelain Protected Wiring—does a far better job from the standpoint of simple installation, low cost, safety, long life and dependability. It's the *right* method for those who "Wire Today for Tomorrow's Loads". Meets all requirements of directives calling for non-metallic wiring and non-metallic wiring materials. Talk it over with your community's efficient watchdog of fire prevention—the Electrical Inspector. Write for manual.



PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO

Wire Today for Tomorrow's Load

PROTECT ALL CIRCUITS WITH G-E FUSES

WHETHER you need enclosed cartridge fuses with 600 ampere capacity or 15 ampere plug fuses, you'll find them all in the G-E line. Many kinds and sizes are available. The G-E line includes:

1. *Non-renewable enclosed fuses*, either indicating or non-indicating with 1 amp. to 600 amp. capacity, 250 or 600 volts.
2. *Renewable enclosed fuses* with 3 amp. to 600 amp. capacity, 250 or 600 volts.
3. *Silvend fuses* with silver-plated contacts with 3 amp. to 600 amp. capacity, 250 or 600 volts.
4. *Pyrex* plug fuses* with 3 amp to 30 amp. capacity, 125 volts.

All of these fuses are made of the best materials. They are thoroughly tested and accurately rated. The Silvend fuses are designed for use with apparatus having silver-plated fuse contacts. Heating due to oxidation does not occur with this combination. The Pyrex fuses have magnifying windows for easy reading.

For further information, see the nearest G-E Merchandise Distributor or write to Section D641-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

*Reg. U.S. Pat. Off.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M., EWT, NBC. "The World Today" news every weekday 6:45 P.M., EWT, CBS.

BUY WAR BONDS

GENERAL ELECTRIC

buying a new home, or modernization or re-equipping an existing home, the Club is presenting a series of discussions on such subjects as financing, selection of location, modern home designs, construction, *wiring and lighting*, kitchen and laundry planning, heating and air conditioning, landscaping, interior decoration and home furnishing.

Club members are also furnished with house publications and other material prepared by national manufacturers giving the latest developments on building, materials, electrical equipment, furnishings and other items. Available to members also are special facilities set up relative to financing, choice and procurement of electrical equipment, interior decoration and furnishings. An endeavor will be made to give prior consideration to members when such equipment is available.

The Club is being sponsored by the Boston Store, The Electric Company and American Institute of Architects cooperating with the Marshall & Ilsley Bank acting as depository. Special passbooks are being issued to members who open a Plan Your Home Savings Account.

DATES AHEAD

Rocky Mountain Chapter IAEI—Monthly meeting, Room 385, City and County Building, Denver, Colo., June 13.

Independent Electrical Contractors Association, Inc.—Monthly meeting, Electrical & Gas Association of N. Y. Headquarters, New York, June 14.

National District Heating Association—Annual meeting, William Penn Hotel, Pittsburgh, Pa., June 14-15.

National Industrial Service Assn.—Tennessee Chapter meeting, Read House, Chattanooga, June 17.

Nebraska-Iowa Chapter, I. E. S.—Fort Des Moines Hotel, Des Moines, Iowa, June 18.

Iowa Utilities Association—Postwar planning conference, Des Moines, Iowa, June 19-20.

American Society of Agricultural Engineers—Annual meeting, Schroeder Hotel, Milwaukee, Wis., June 19-21.

American Society of Mechanical Engineers—Semi-annual meeting, William Penn Hotel, Pittsburgh, Pa., June 19-22.

Society for Promotion of Engineering Education—Annual meeting, University of Cincinnati, Cincinnati, Ohio, June 25-28.

American Institute of Electrical Engineers—Summer Technical Meeting, Jefferson Hotel, St. Louis, Mo., June 26-30.

American Society for Testing Materials—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., June 26-30.

International Association of Electrical Inspectors — Northwestern Section, Olympian Hotel, Olympia, Wash., August 21-23; Southwestern Section, Modesto Hotel, Modesto, Calif., August 28-30; Western Section, Claypool Hotel, Indianapolis, Ind., September 11-13; Eastern Section, New York, N. Y., September 18-20; Southern Section, Ausley Hotel, Atlanta, Ga., September 25-27.

American Institute of Electrical Engineers—Pacific Coast Technical Meeting, Biltmore Hotel, Los Angeles, Calif., August 29-September 1.

American Standards Association—Standards Council, New York, N. Y., September 21.

National Electrical Contractors Association—Annual meeting, French Lick Springs Hotel, French Lick, Indiana, Oct. 1-5.

National Safety Congress of National Safety Council—Sherman, Morrison and La Salle Hotels, Chicago, Ill., October 3-5.

National Electrical Manufacturers Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 23-27.

International Lighting Exposition.—Palmer House, Chicago, Ill., April 19-23, 1945.

MANUFACTURERS NEWS

G-E APPOINTMENTS

Robert S. Peare, manager of publicity and broadcasting for the General Electric Company since 1940, and chairman of the company's general advertising committee, has been elected a vice president. In his new position, Mr.

R. S. PEARE

Peare will direct the company's advertising, broadcasting, and general publicity activities as a member of the president's staff.

W. V. Merrihue has been named manager of the advertising and sales promotion divisions of the Apparatus Department of GE. Simultaneously he was named a member of the apparatus

W. V. MERRIHUE

sales committee of the company. He was assistant to the manager of the apparatus publicity divisions.

H. V. Erben, manager of the central stations divisions of G-E since 1941, has been elected a commercial vice president.

R. P. Van Zile has been appointed district manager of the East Central District No. 5 of G-E's Electronics Department. He will be responsible for the sale of all products of the department in this district and his headquarters will be at 4966 Woodland Avenue, Cleveland.

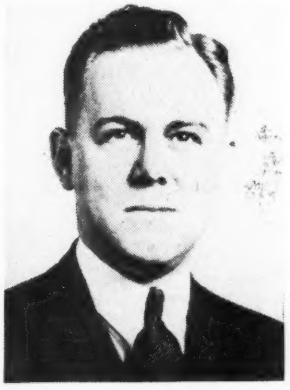
H. V. ERBEN

Everett G. Agee, who for the past 15 years has served as a salesman for Midwest Sales District of General Electric's Lamp Department, has been promoted to the post of manager of that district with headquarters at Kansas City. He succeeds the late Howard F. Viot.

SYLVANIA PROMOTIONS

Sylvania Electric Products, Inc., has announced the promotion of Garlan Morse to the position of product manager, incandescent and fluorescent lamps. He joined Sylvania in 1936, working on construction and cost accounting in the Radio Division. Transferring to the Lighting Division, he was on the New England sales staff, then on wiring devices, before his assignment as sales manager for the Lighting Division at Philadelphia.

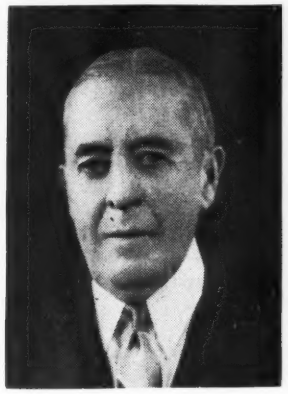
H. H. Rainier has been appointed assistant manager, Distributor Sales, Radio Division. He will be responsible for merchandising activity through Division managers in all territories and will report directly to R. P. Almy, manager of Distributor Sales, Radio Division.



GARLAN MORSE

WESTINGHOUSE ELECTIONS

William C. Robinson, president of the National Electric Products Corporation, has been elected a member of the Board of Directors of the Westinghouse Electric and Manufacturing Co. He is also a director of the West Penn Power



W. C. ROBINSON

Company, Jones & Laughlin Steel Corporation, Mellon National Bank and the Union Trust Company of Pittsburgh.

Westinghouse has elected four new vice presidents. The new officers and their former positions are R. A. Neal, manager of the Switchgear Division at the East Pittsburgh Works; J. K. B.

R. A. NEAL

Hare, manager of the Company's Central District sales activities with headquarters in Pittsburgh; John H. Ashbaugh, manager of the Westinghouse Electric & Appliance Division, with headquarters in Mansfield, Ohio; and H. H. Rogge, manager of the Company's Washington Government Office.

Mr. Neal, who came to Westinghouse in 1910 becomes vice president and sales manager, reporting to B. W. Clark, who is vice president in charge of all sales activities of the company. Mr. Rogge for the time being will continue to make his headquarters in

Synthetic-Rubber Replaces NATURAL RUBBER INSULATIONS AND SHEATHS ON SIMPLEX WIRES AND CABLES

Early in the war the scarcity of natural rubber made conservation necessary in order to make the best use of what was available. Our standards of quality and service had to be maintained with less rubber than we had been using. A few months ago, because of the rapidly dwindling supply of natural rubber, a complete change to synthetic rubber became imperative. Natural rubber could no longer be used in conductor insulation or cable sheath.

In anticipation of just such a situation, we already had investigated available substitute materials and were well along in the development of insulations and sheaths to replace all of our standard natural compounds. The change-over is now practically complete.

A synthetic rubber compound has been provided to replace each of our special purpose, natural rubber insulations and sheaths. Laboratory tests and service records already indicate that they may be depended upon for trouble-free, efficient service. The technical and engineering skill that made our natural rubber compounds outstanding is now focused on obtaining even better quality and service with the new synthetic compounds.

If your postwar plans call for insulated wires and cables, or if you need them now for essential war work, it will be well worth your while to learn more about Simplex wires and cables with their new synthetic insulations and sheaths.

Simplex WIRES and CABLES

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

BELfone INTERCOMMUNICATION SYSTEMS

For complete, swift, private communication between any or all offices, departments, or executives. BELfone speeds inter-office cooperation, clears telephone lines for outside calls, ends wasted steps and time. Economical standard units combine to fill needs of any type or size. Write for details.

BELL SOUND SYSTEMS, Inc.

1196 Essex Avenue Columbus, Ohio

Export Office: 5716 Euclid Ave., Cleveland, Ohio

BELL SOUND SYSTEMS

J. K. B. HARE

Washington. The responsibilities of Mr. Hare and Mr. Ashbaugh are unchanged.

R. L. Irvin has been appointed application manager, Small Motor Division of Westinghouse, Lima, Ohio.

R. L. IRVIN

He was formerly industrial manager of the Company's Northwestern District with headquarters in Chicago.

Quincy M. Crater has been named assistant manager of the Westinghouse Detroit office territory. His office will be at 5757 Trumbull Avenue, Detroit.

Andrew C. Nelson has been appointed manager of the Middle Western District, Westinghouse Lamp Division, with headquarters in Chicago.

OFFICERS ELECTED BY FARADAY

Announcement has been made of the election of officers of the Faraday Electric Corporation, of Adrian, Mich., which is a consolidation of the Stanley & Patterson Company and the Schwarze Electric Company.

E. I. Kleinman, president; J. S. Ackerman, vice president; J. M. Doroshaw, vice president; L. J. Stern, executive vice president; P. H. Hill, vice president in charge of sales; F. Von Voigtlander, vice president in charge of engineering; N. Cellentani, vice president in charge of manufacturing; J. S. Rodie, secretary and treasurer and P. C. Reck, assistant treasurer. The first three named are residents of Chicago and owners of the company. The others are all residents of Adrian.

ALLIS-CHALMERS APPOINTMENTS

The appointment of John Avery as manager of the Allis-Chalmers blower and compressor department to succeed G. L. Kollberg was announced by W. C. Johnson, vice president. Mr. Kollberg, who is retiring after 47 years of service with the company, will continue as consultant and adviser on the engineering matters with which he has been intimately associated for so long. Mr. Avery has been assistant manager of the blower and compressor department since 1925.

Creation of a new Allis-Chalmers research and gas turbine development division has recently been announced by R. C. Allen, manager of the company's steam turbine department. Dr. J. T. Rettaliata has been appointed manager of the new division. As chief engineer in gas turbine development, J. L. Ray will assist Dr. Rettaliata.

U.S. RUBBER APPOINTMENTS

C. W. Higbee, manager of the wire and cable department, United States Rubber Company, has announced the appointment of Alexander S. Basil as assistant factory manager of the Lowell, Mass., plant.

I. L. Cantwell, former production manager of the Bristol plant, has been named sales manager of battery separators.

Ernest G. Brown has been named general manager of mechanical goods, general products and "Lastex" yarn and rubber thread divisions, succeeding Willard H. Cobb, recently elected vice president and member of the executive committee.

•

The Trumbull Electric Mfg. Co. of Plainville, Conn., announces the establishment of a separate Southeastern District under the management of H. S. Hill, for many years in charge of the Atlanta office, with headquarters in the Red Rock Bldg., Atlanta 3, Ga. Associated with him are E. E. Frost and A. T. Allison, who have been operating out of Nashville and Charlotte respectively and Hugh N. Delinger in New Orleans, replacing M. Turner, now located in the Cincinnati District, with headquarters at the Norwood factory.

•

Allen-Bradley Co. of Milwaukee, announces the removal of its New York offices to 155 East 44th Street, New York 17, N. Y. C. N. Calkins remains in charge as New York district manager.

The Cleveland office of Allen-Bradley has moved to 4506 Prospect Road, Cleveland 3, Ohio. This office remains in charge of R. J. Roy, Cleveland district manager.

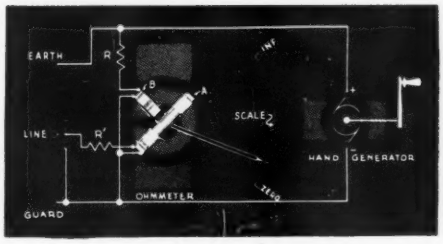
. . . THE "MEGGER"* INSULATION TESTER

The dependability of the "Megger" Instrument for measuring electrical insulation resistance is like the constancy of Ohm's Law, on which principle it actually operates. This "Megger" method for testing insulation resistance is simple and remarkably accurate. The principle is precisely the same as it was forty years ago and yet it meets today's needs perfectly.

You will find the same ruggedness and dependability in U.S.-made "Megger" instruments that the electrical industry has known for so long a time.

Let us send you full details on various types and ratings. Ask for Bulletin 1685-EC.

* *Trade Mark Reg. U. S. Pat. Off.*



PRINCIPLE OF OPERATION

In what we term a cross-coil true ohmmeter, two coils are mounted in fixed relation to each other on the same pivot-and-jewel moving system in the field of a permanent magnet. "Current" flows in coil A and "potential" in coil B, and they are connected so that their respective torques oppose each other. Since there are no control springs, the opposing coils give a true ratio of E/I, and ohms (or megohms) are indicated directly by a pointer over a scale. The readings are independent of the voltage of the hand-driven d-c generator, because any change in the voltage affects both coils in the same proportion.

JAMES G. BIDDLE CO. 1211 ARCH ST. PHILA. 7, PA.

GOLD SEAL TAPE

Watch the tough, long "teeth" form when you unwind it! A sure sign of stronger adhesive power . . . assurance of a tighter, longer-lasting, safer job. Gold Seal insulates with one thickness . . . stays tacky in cold weather, yet doesn't ooze in hot weather. Doesn't peel or ravel. Sealed in cellophane, then boxed, to stay fresh. A good supply house near you stocks Gold Seal Friction and Rubber Tape. Also Diamond Seal "Specification" Tapes that meet ASTM and Federal specifications. JENKINS BROS. (Rubber Division, 80 White Street, New York 13, N. Y.

JENKINS *Gold Seal Tapes*

FRICTION • • RUBBER

What's New in **STAGE SWITCHBOARDS**

WRITE FOR YOUR COPY OF THIS NEW, INFORMATIVE BOOKLET

CUSTOM BUILT SWITCHBOARDS

•

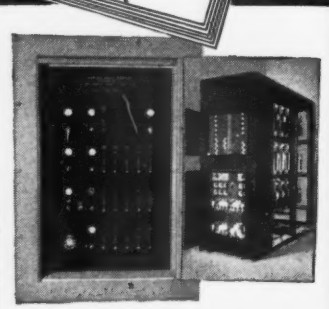
STAGE and GENERAL LIGHTING EQUIPMENT

Today our shops are almost entirely occupied with war projects such as Marine Switchboards, Stage Switchboards and Lighting Equipment for Army, Navy and Air Corps installations. But where priorities permit and materials are available, we can still fill orders for industrial and other applications.

If we or our Resident Engineer nearest you can be of assistance, please call on us. And let us send you our new booklet which describes the latest developments in Stage Switchboard design.

HUB ELECTRIC CORPORATION

2227 West Grand Avenue • Chicago 12, Ill.



HUB-REGULITE stage switchboard at Norfolk Naval Hospital, Portsmouth, Va. Pilot control station and remote switchboard are illustrated.

The Fostoria Pressed Steel Corporation of Fostoria, Ohio, has named E. H. Robinson as Eastern sales manager. Until recently, he was consulting engineer on illuminating problems for General Electric at Nela Park. Mr. Robinson will be responsible for the Fostoria Industrial Service Centers at Cleveland, Buffalo, Boston, New Haven, New York, Philadelphia and Pittsburgh. His headquarters will be in Cleveland, Ohio.

E. H. ROBINSON

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Appleton Electric Company, Chicago, Ill., announces the appointment of Julian Hawks as Eastern manager. He will have charge of all company business in the Eastern District, which comprises the New England states, New York, New Jersey, Eastern Pennsylvania, District of Columbia and Virginia.

Mr. Hawks has been associated with the electrical industry since 1925. He was a manufacturers' agent and then vice president of Triangle Conduit & Cable Co. Since 1942 he was chief, Electrical Section, Wholesale & Retail Trade Division of the WPB.

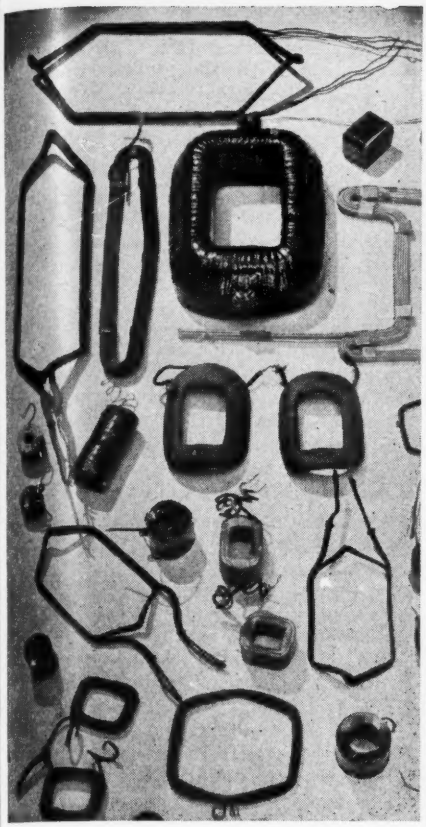
•

Graybar Electric Company has appointed S. W. Scott as district commercial manager at Los Angeles, succeeding W. E. Guy, who has become district commercial manager at the Chicago office. Mr. Scott joined the company in 1928 as a supply salesman in Los Angeles, and later served as manager of the Merchandise Department and as Hearing Aid specialist in Los Angeles.

•

Stromberg-Carlson Company, Rochester, N. Y., has named Dr. George R. Town manager of research and engineering. Dr. Town joined the staff in 1936 as an engineer in the research laboratory. In 1940, he was made engineer in charge of the television laboratory and in 1941, he became assistant director of research.

Prior to joining Stromberg-Carlson, Dr. Town worked as research and development engineer at Leeds and Northrup Company in Philadelphia, and at the Arma Engineering Company in Brooklyn, and as instructor in electrical engineering at RPI.



INSULATING VARNISHES

to meet all coil requirements

No matter what type of units you rebuild, you will find a DOLPH Insulating Varnish to meet your coil requirements. Through our vast experience, we have developed several hundred different varnishes and each grade is formulated to do a specific job.

Perhaps you do not know just what varnish to specify for treatment of your coils. As we maintain laboratory service, we are confident that we can help you with your problem. There is no obligation, so why not let us assist you?

Dolph's

JOHN C. DOLPH COMPANY

Insulating Varnish Specialists

168-A Emmet St., Newark, New Jersey

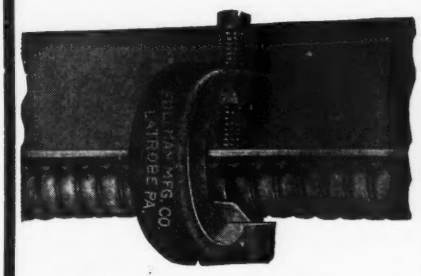
LATROBE

FLOOR BOXES — WIRING SPECIALTIES

PRODUCTS

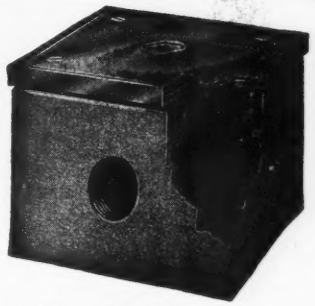
QUALITY THAT LASTS

Time saved in installing Latrobe Products is a major factor of preference—especially in plants where even momentary "down-time" may affect war production schedules. Latrobe Products are safe, too, and long lasting.



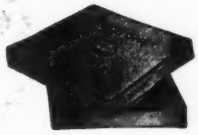
"Bull Dog" Armored Cable Support

For supporting armored cable to steel framework. Light, strong, sure grip. Will not deface surface.



Floor Junction Boxes

This 5" x 5" x 4" Box with adjustable cover is one of a great variety of standard boxes. Special sizes can be turned out promptly.

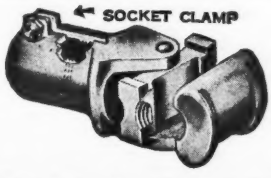


Keystone Fishwire

High quality flat steel wire properly tempered to give stiffness and springiness. Sizes for all power wiring. Packed in cartons.

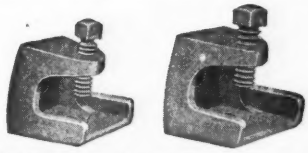
No. 330 Utility Box

For use in wood floors, baseboards, show windows and other installations free from moisture or mechanical injury. No superfluous parts.



No. 625 "Latrobe" Conduit Bender

Combination ½" and ¾ in. conduit bender with reversible jaw to fit either side. Will not slip nor kink conduit.



"Bull Dog" Insulator Supports

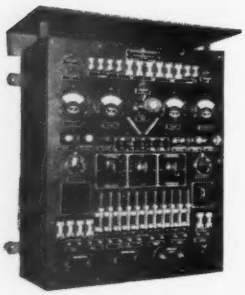
Convenient little clamps of high tensile strength for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

EASILY INSTALLED

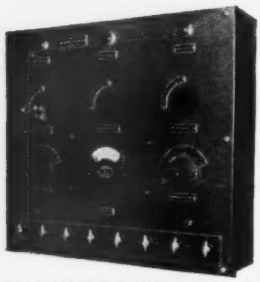
FULLMAN MANUFACTURING CO.
LATROBE, PA.

ECONOMICAL

Electrical Specialties
of Every Type
Including MARINE WORK



WORK TEST PANEL—built to customers' specifications and Navy standards.



RADIO MOTOR-GENERATOR and SELECTOR CONTROL PANEL—built to customers' specifications for any number of circuits.

JMM CO

ALL types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army, Navy and Commercial specifications. Full engineering personnel and equipment for manufacture of special electrical items to customers' needs in addition to all standard articles. Let us quote you on your requirements. Write for illustrated catalog.

Jacksonville Metal Manufacturing Company
247 Riverside Avenue
Jacksonville, Florida

NEED REPLACEMENT COMMUTATORS?

Contact TOLEDO *Immediately*

Let us send you our catalog and recently issued Stock List to help you in maintaining the electric motors entrusted to your care. Many commutators are available from stock which can be adapted to your use with a little ingenuity.

The vastly expanded facilities of our three plants make it possible to offer the widest range of sizes carried by any manufacturer. Commutators are also carried in stock at 249 High St., Newark 2, N. J. and 324 No. San Pedro St., Los Angeles, 12, Calif. for the convenience of our customers.

Address Gordon R. Campbell, Sales Manager, for a catalog and stock list.

TOLEDO STANDARD COMMUTATOR CO. – Toledo 6, Ohio
HOMER COMMUTATOR CORP. – Cleveland 3, Ohio
HILLSDALE COMMUTATOR CO. – Hillsdale, Michigan
THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMMUTATORS

The Wiremold Company of Hartford, Conn., has named J. E. Love, district manager at Pittsburgh to cover the western section of upper New York State and G. W. Sundstrom, district manager at New York to cover the eastern section of upper New York State. This territory was formerly handled by E. E. Card, who has resigned.

•

The National Supply Company of Pittsburgh elected Albert T. Huizinga vice president and treasurer. Mr. Huizinga joined the company as treasurer in 1943, coming from Montgomery Ward & Company, Chicago, where he had been assistant treasurer. Prior to his association with Montgomery Ward, he had been in the banking business in Chicago for 12 years.

•

P. R. Mallory & Co., Inc., Indianapolis, Ind., has announced the appointment of Earl R. Sayre as an application engineer for the company's line of electrical, electronic and metallurgical products. Mr. Sayre was formerly associated with the Arrow-Hart and Hegeman Electric Company.

•

The Dumore Company of Racine, Wis., has announced the appointment of James Tate as director of marketing. Previous to joining the Dumore organization he had been vice president and general sales manager of the Delta Manufacturing Company of Milwaukee, managing editor of *Popular Homecraft* and Technical editor of *Popular Mechanics.*

•

The Manco Mfg. Co., of Bradley, Ill., has purchased the Carolus Line of bolt and wire cutters, end cutters and nut splitters. Manco will continue to manufacture the Carolus Line and will maintain stocks of Carolus replacement parts for the cutters now in service.

•

Champion Lamp Works of Lynn, Mass., Division of the Consolidated Electric Lamp Company, has moved its New York office from 152 West 42d Street to larger headquarters in the Graybar Building, 420 Lexington Avenue.

•

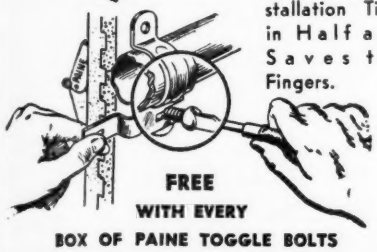
Dale R. Morgan, formerly of the Midwest Supply Co. of Des Moines and for the last two years connected with OPA in Washington, has joined the **Delavan Engineering Company** of Des Moines, Iowa. He will head the utility engineering sales section of the Delavan Company, representing the **Standard Transformer Company** of Warren, Ohio, in the states of Iowa and Nebraska.

For STRENGTH SPEED • SAFETY

Use PAINE TOGGLE BOLTS

In HOLLOW MATERIAL • INSTALL With PAINE TOGGLE BOLT CLAMP

Clamp Cuts Installation Time in Half and Saves the Fingers.



FREE WITH EVERY BOX OF PAINE TOGGLE BOLTS

PAINE CONDUIT CLAMP

All clamps are rust resistant. Furnished with correct size stove bolt and nut in each clamp to save time counting bolts and nuts for each clamp when purchasing, and to reduce installation time. Manufactured in rigid and thin wall sizes.

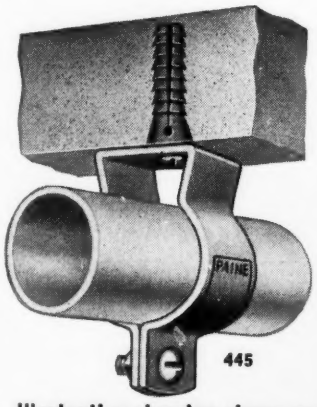


Illustration showing clamp anchored with PAINE Woodscrew Lead Anchor, Fig. 950, in concrete.

Ask your Supplier or write for Catalog.

THE PAINE CO.

2961 Carroll Ave., Chicago 12, Ill.

Offices in Principal Cities

PAINE FASTENING and HANGING DEVICES

Equipping Your Small Motor Department

[FROM PAGE 65]

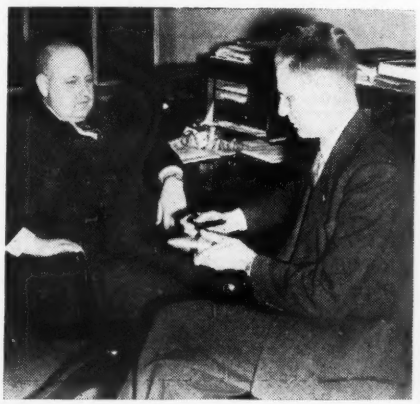
ment would approximate $6,000. If you added the complete list of "improvement" equipment, your investment would total approximately $8,000. These figures, of course, cover only the investment cost and not the cost of an initial stock of parts, spare motors, armatures, stators and other accessories. These items will be discussed in a subsequent article on "Operating Your Small Motor Department."

It is important that you survey your potential volume before making the investment. If the necessary volume does not exist, proceed with caution because one of the prime requisites of a successful small motor shop is volume. Do not attempt to operate on a "shoe-string" basis. If you do, you will become another supporter of the old theory that the small motor business doesn't pay.

You should have sufficient volume to enable you to work on a mass production basis—with a certain man for each operation. A man can be trained more quickly to do specific phases of repair work and will turn out more and better work than if he has to learn to be an all-around man.

The *minimum volume* on this basis would be from 15 to 25 motors per day and would require from 8 to 10 workers.

This clear-cut picture of the equipment, layout, investment and volume necessary for successful small motor shop operation is based on personal experience in the field and visits to numerous other shops. It is presented as a guide to those who anticipate going into this field in the future and those who, already in the field, find it difficult to operate economically.



THE EFFECT of plant relighting on employee morale and production is discussed by Walter Teut (left), plant superintendent, Milwaukee Gas Specialty Co., and Earl H. Aik, Milwaukee illumination engineer who designed the plant's new fluorescent lighting system.

Millions now in daily use

● Aerovox has supplied the major portion of all motor-starting capacitors — and the number is well up in the millions. It will pay you to bear that fact in mind when it comes to capacitor replacements to keep those electric refrigerators and other appliances running for the duration at least.

VICTORY LINE REPLACEMENTS

Aerovox offers 22 types of electrolytic capacitor replacements for 110-volt operation; 6 types for 220-volt.

These 30 universal types can take care of upwards of 90% of all motor-starting capacitor replacements.

Handy Aerovox conversion chart indicates Victory equivalent for any previously available type.

● Ask your jobber about Aerovox motor-starting capacitor replacements. Ask to see the conversion chart—or write us direct.

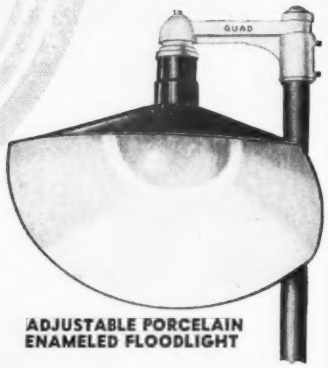
AEROVOX Capacitors INDIVIDUALLY TESTED

AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.

In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.

Export: 13 E. 40 St., New York 16, N.Y. Cable: 'ARLAB'

QUADRANGLE
RLM
QUAD
LIGHTING UNITS



ADJUSTABLE PORCELAIN ENAMELED FLOODLIGHT

A few things for contractors to remember about QUAD Units . . . they all have correct basic design and construction features and will give customers highest lighting efficiency. A full line of Industrial Lighting Equipment that stays popular. QUAD . . . for today and for tomorrow.

• Manufacturers of Incandescent and Fluorescent Lighting Equipment

QUADRANGLE MFG. COMPANY
32 S. PEORIA ST.
CHICAGO, ILLINOIS

CHICAGO
EXPANSION NUTS

The Dependable Machine Screw Anchors

For machine screw or machine bolt anchors, it will pay you to specify Chicago Expansion Nuts. These dependable anchoring devices offer the following advantages:

1. **Quickly installed—a few hammer taps sets them.**
2. **Work can be easily dismantled.**
3. **No part of the anchor projects after removal from floor or wall.**
4. **Large stocks—IMMEDIATE DELIVERIES.**

Chicago Expansion Nuts have standard machine screw threads. Available in all sizes from No. 6 up to and including ¾". Setting tool free of charge.

IMMEDIATE DELIVERIES

Write for New Catalog.

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Shift Your Business into High Gear

with
EXECUTONE
"INTER-COM" SYSTEM

Work flows with greater smoothness—*greater speed*—the moment you install EXECUTONE. A mere press of a button gives you immediate voice-to-voice contact with any member of your organization. Reports are made—questions asked and answered—without a man leaving his desk, without a moment wasted. EXECUTONE relieves your switchboard of "inside" traffic... saves you time, money and manpower.

The "inter-com" system selected by the U. S. Navy for many of our fighting ships.
Write for FREE booklet "H-10"

Executone
COMMUNICATION SYSTEMS
415 Lexington Ave., New York 17, N. Y.
Service in Principal Cities
Back the Attack—Buy More War Bonds!

Estimating Cubicle Switch Gear Work

[FROM PAGE 59]

B. Connecting ground busses between cubicles and to grounding system. This is a separate item from making the regular cubicle bus connections.

C. Installing barriers and fuses, which come unmounted, in the disconnect switch compartments of the cubicles.

D. Filling the circuit breakers with oil—an item which takes considerable time.

E. Leveling the board—a real chore with large equipment.

F. Cleaning the board—a chore that can be lightened by protecting the units from weather and painters splashing brushes.

Now that we have listed the salient items that bear careful consideration when estimating cubicle work, let's see how much labor was involved in the installation of an 18-section, 2300-volt cubicle board in the water filtration plant of a midwestern ordnance plant. Cartage to building is not included in the table since this item will vary considerably on different jobs. The units presented cover moving the board from ground level outside to the interior of the building, setting them and making the necessary bus connections and other miscellaneous assemblies.

Description of Equipment

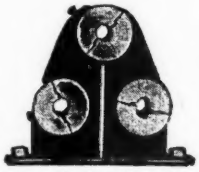
For the units to be of any value whatsoever, either as a guide or for check purposes, a description of the equipment and installation technique is pertinent. The equipment (illustrated in the accompanying sketch) to which the units apply consisted of an 18-cubicle 2300-volt board. It was delivered and installed in the following sections: a 3-cubicle service section (two 1200-Amp. incoming services and one surge protective totalizing panel measuring approximately 10-ft. high, 7-ft–6-in. deep, weighing about 9500 pounds (crated) and delivered in two horizontal units; six two-cubicle sections 7-ft.–6-in. high, 5-ft.–8-in. wide, 3-ft–6-in. deep, weighing about 1500 pounds each (crated); and one three-cubicle section 7-ft–6-in. high, 8-ft.–6-in. wide, 3-ft.–6-in. deep and weighing about 2250 pounds (crated). Sections had to be bolted and bussed together. Bus work for service cubicle came knocked-down and had to be installed

[Continued on page 168]

SIMPLICITY PLUS!

New **NON-INDUCTIVE CABLE RACK**

for INDUSTRIAL PLANT WIRING



Type D-F 3-Conductor Cable Rack. New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2⅜".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushings.

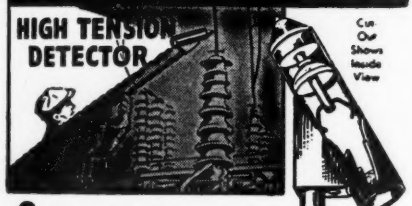
Send today for Bulletin C-S-51 which illustrates the complete line

THE M. & W. ELECTRIC MANUFACTURING CO., INC.

EAST PALESTINE, OHIO

Safe-T-Glow

HIGH TENSION DETECTOR



Cut-Out Shows Inside View

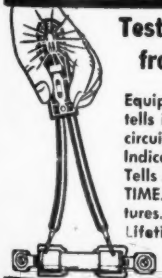
SAFETY RULES call for that EXTRA precaution and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts. Model B for circuits from 35,000 to 220,000 volts.

Model A 3-ft. handle

Model B 6-ft. added extension

TEST-O-LITE



Tests Everything Electrical from 100 to 550 Volts

Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List $.. (Priority A-7) Purchase thru regular electrical dealers.

L. S. BRACH Mfg. Corp.

55-63 Dickerson St. Newark, N. J.

AT 150°C

THE G-E INSULATING VARNISH WAS UNCRACKED

Rigid tests of each new varnish developed by General Electric is a prime prerequisite to placing it on the market. And, naturally, these tests are made under conditions duplicating, in a more exacting degree, those which the varnish is compounded to meet. Typical was the test of two varnishes, each intended for insulating electrical apparatus where high temperatures would be encountered. The G-E varnish withstood the accelerated heat-aging test; the other broke down.

If you face a problem in finding the correct insulating varnish for your specific needs, the engineering staff of the Resin and Insulation Materials Division of the General Electric Company will gladly co-operate with you. Consult your local G-E Distributor or write to: Section M642-8, General Electric Company, Schenectady 5, New York. (Varnishes are one product in the complete line of G-E insulation materials.)

THERE IS A G-E INSULATING VARNISH FOR EVERY NEED

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AUTHORIZED PARTS DISTRIBUTORS

Brown-Brockmeyer	General Electric	Master
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Electrical Connectors

MAIL THIS COUPON TODAY

Please send details and 32-page illustrated catalog.

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TEST INSULATION THE MODERN WAY

... WITH A MODEL B-5

MEGOHMER

NEW BATTERY-VIBRATOR TYPE

No more tiresome cranking of a hand-driven generator. Entirely self-contained. Steady test potential of 500 volts D.C. available at the touch of a switch. Direct reading in insulation resistance. Various new models and ranges.

Write or phone for Bulletin 430

HERMAN H. **Sticht** COMPANY, INC.

27 PARK PLACE NEW YORK, N. Y.

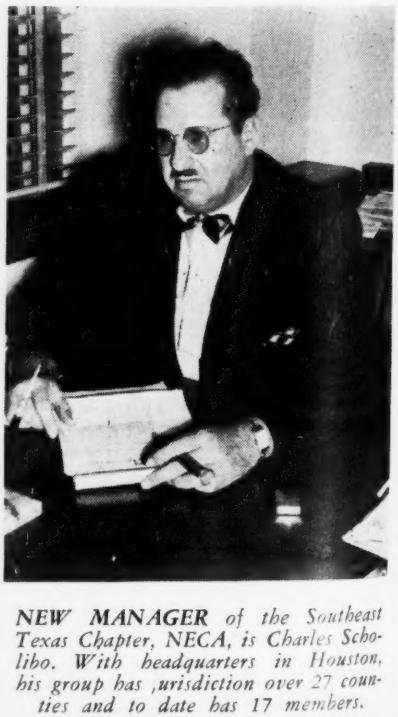
Estimating Cubicle Switch Gear Work

[FROM PAGE 168]

taped and varnished. A single ground bus running through the cubicles had to be connected at the sections. Six of the "distribution" cubicles fed 250 hp. motors, six fed 200 hp. motors; two fed 60 hp. motors; and one fed a bank of three 25 kva., single-phase, 2300/-440-volt transformers for incidental power. Each of these 15 units with 2300-volt, across-the-line oil switches (to conserve critical materials) had a hook-type disconnect switch on the line side. Service to the board consisted of two 4½-inch conduits each with a 3-conductor, 500 MCM, V. C., lead covered cable and two 3½-inch conduits each with a 3-conductor, 300 MCM, V. C., lead covered cable.

The equipment had to be picked up at the track-side, transported to an area warehouse and moved to the building at a later date when construction progress permitted installation. This labor is not indicated in the table.

The precautions presented here apply to estimating any type of cubicle equipment. The labor data is offered as a guide to those who may encounter work of this type. Unfortunately, there is no hard and fast rule for estimating electrical construction work. Each job must be figured on its own merits. But, in all cases *the estimate must be complete.*



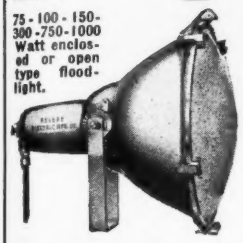
NEW MANAGER of the Southeast Texas Chapter, NECA, is Charles Scholibo. With headquarters in Houston, his group has jurisdiction over 27 counties and to date has 17 members.

INSTALL *Revere*
FLOODLIGHTS *and* EQUIPMENT
ON THAT NEXT JOB

750 - 1000-1500 Watt Enclosed type Floodlight with rotation feature.

EASY TO WIRE
•
SUPERIOR DESIGN

300 to 1500 Watt Elliptor open type floodlight.



75 - 100 - 150-300 - 750 - 1000 Watt enclosed or open type floodlight.

REVERE
The Complete Quality Line
A logical choice for contractors
Designed for outstanding efficiency
Sold through your Wholesaler
Catalog data on request

High Bay Type Reflectors in Steel and Mirrored Glass.

REVERE ELECTRIC MFG. CO.
2925 NORTH PAULINA STREET · CHICAGO 13
Originators of the Hinged Floodlight Pole
INDOOR and OUTDOOR LIGHTING EQUIPMENT of EVERY DESCRIPTION

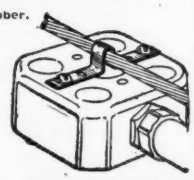
MINERALLAC

New Practical Unit to Cut Installation Time

• The "Messenger Hanger" and the "Messenger Strap" fill the need for an economical, practical, time-saving unit for use with the new messenger cable type of installation. Mechanically strong, durable, lightweight. They save considerable materials and are easily and quickly installed. Our bulletin gives full and complete details—send for it.

See your Jobber.

"Messenger Hanger" for Conduit and Cable Strong, made of Cadmium Plated Steel or Everdur. Top loop of hanger grips messenger cable to permit conduit to be put in place without falling off.



"Messenger Strap" for Outlet Boxes Of Cadmium Plated Steel or Everdur. For messenger cable installation to be used with Minerallac "Messenger Hanger." Fits all standard outlet boxes and 3/8" messenger cable.

MINERALLAC
ELECTRIC COMPANY
New York City Office 50 CHURCH ST.
THEODORE B. DALLY
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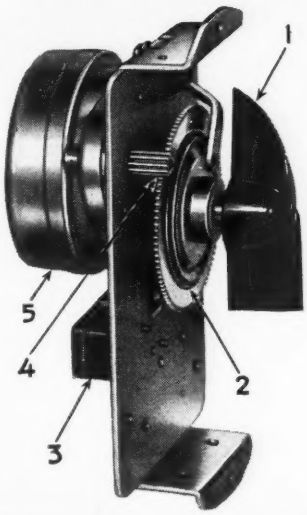
Another Paragon Timer *achievement!*



Here's a notable development in automatic electric timers . . . which includes several distinct engineering and operating improvements.

ENGINEERING FEATURES

1 The setting knob is directly connected thru the switch operating cam; unit does *not* set thru a clutch; this provides positive switch action.

2 All energy required to operate switch itself is built up by manually setting pointer. Motor and clutch thereby relieved of all drag.

3 Switch—single pole, double throw, 1000 watt capacity, fully enclosed. Underwriter's approved.

4 Only 2 exposed gears—motor pinion and wheel. Precision hobbed.

5 Motor—self starting, slow speed, industrial type synchronous, completely sealed.

6 No energy is required of clock motor to trip switch at end of present time.

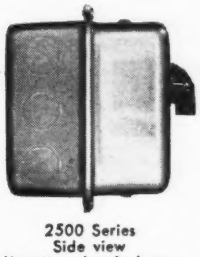
7 Nine time ranges from 0 to 14¼ seconds through 0 to 9¼ hours. Available in all types of enclosures.

8 All parts rust proofed and protected against corrosion.

2400 Series
For flush mounting

2900 Series
Wall mounting

2500 Series
Enclosed type



2500 Series
Side view
Mounts on handy boxes

NUMEROUS APPLICATIONS

Adaptable to any manually preset application with automatic switch operation at end of time cycle, such as plastic molding, rubber curing, batch mixing, heat treating, enamel baking, liquid agitation, light exposure—photographic, therapeutic, blue printing, infra-red drying,— blower operation, pump operation, conveyor operation and food processing.

PRECISION BUILT: This and every other Paragon unit is precision built, simple, accurate, reliable, modern and reasonably priced. Made by an organization of designers and engineers, growing since 1905.

SEND FOR BULLETIN . . . ***containing complete construction and installation data.***

PARAGON ELECTRIC COMPANY
401 S. DEARBORN ST. • CHICAGO 5, ILL.

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BUILDERS OF ELECTRICAL EQUIPMENT . . . SINCE 1905

You get the BEST in Time Switch Experience WITH BADGER

• This BADGER Synchronous Automatic Time Switch is specifically a heavy duty model with a capacity great enough to meet a wide variety of requirements. There is constant demand for these sturdily constructed time switches with more than thirty years of proven dependability to recommend them.

They are completely automatic and are furnished in single and double pole construction with indoor and outdoor cases.

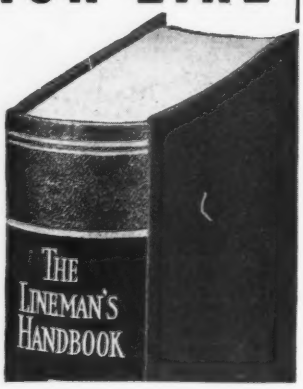
You can guarantee accurate timing, economical operation, and years of dependable service for your customers. See your Wholesaler or send for catalog.

• *Prompt delivery on orders rated AA-5 or Higher.*

Type	Poles	Switch Capacity	Case
M1 (Synchronous)	1	50 A. at 125 V.	16 Ga. Steel
M2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V.	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN

That TRANSMISSION LINE fact you want is HERE



No matter what it may be, you will find complete data in this practical handbook for linemen, foremen, and other employees of line departments. This big home-study and reference volume is filled with the facts you need in order to do quick, safe, efficient work.

2nd edition of **THE LINEMAN'S HANDBOOK**

By Edwin Kurtz

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- Safety Methods in Construction of Overhead Lines
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This handbook covers everything the practical man wants to know about every phase of transmission line work. It is a handy volume packed with workable plans, methods, kinks, short cuts, tables, diagrams and photos on every aspect of materials, poles, towers, stringing, guying, trouble-shooting, first aid, etc. Use it as thousands of other line department workers have—to check your methods against the practice of others, to get fast, dependable answers to problems that arise on the job, to brush up on special points and for consistent study to improve your knowledge, grade and earnings.

10 DAYS' FREE EXAMINATION

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Send me Kurtz—The Lineman's Handbook for 10 days' examination on approval. In 10 days I will send you $4.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

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Portable Electric Tool Maintenance

[FROM PAGE 57]

outgoing drill boxes. They then test and check the armatures and fields, clean the drill, secure any new or repair parts necessary, reassemble the unit, test it and turn it over for final testing and color coding. Burned out armatures and field coils are sent to the armature and coil repair department; broken cords to the cord repair department; and cracked cases and handles to the aluminum welder for possible salvage. Each girl notes on her repair card the nameplate data on the drill, the repairs made, spare or new parts used and the time spent on the job.

Maintenance of a huge spare parts stock is the backbone of this entire repair operation. Since manufacturers, under present conditions, are unable to furnish enough of these items, armatures and field coils are rewound in large lots to continuously replenish the stock pile. About 800 armatures per week are rewound and every week or two, 500 sets of field coils are made for stock. Stacked in the stock room shelves—with separate tiers designated for spare parts for each of the five or six different makes of drills used in the plant—are large quantities of the following items:

For portable electric drills:

1. Rewound armatures—need about 600 on hand at all times
2. Rewound field coils—need about 500 sets on hand
3. Trigger switches
4. Plugs for cords
5. Brushes
6. Bearings
7. Chucks and chuck parts
8. Drill casings
9. Drill hand grips
10. All types of necessary screws, bolts, etc.

For larger motors

1. Holding coils for control apparatus
2. Armature coils
3. Stator coils
4. Bearings
5. Brushes and other items for fractional horsepower motors
6. Heater units for motor switches

Training for Women

An effective training schedule is set up for new women who come into the electric drill repair department. They

[Continued on page 174]

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Reflectors

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- MULTI units have long enjoyed the approval of contractor and user. A minimum of maintenance and care gives you lighting installations that will pay well. They meet all needs whether for commercial or residential lighting.

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—locate breaks in armature windings and do a workmanlike job of rewinding;
—know just what is wrong with an electrical machine and take charge of installation and maintenance work;
—make accurate tests of switchboards and apparatus and correctly balance the power with the load;
—handle every sort of wiring job;
—show competence whether it be in the use of a Stillson wrench or a Wheatstone bridge.

Includes trouble-shooting book

Now, in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a book giving helpful maintenance information, special trouble-shooting charts, explanation of symptoms and causes of machinery trouble, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

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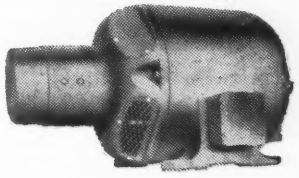

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Portable Electric Tool Maintenance

[FROM PAGE 172]

are first trained, under very close supervision, on the drill repair benches. Here they learn what an electric drill looks like, how it operates, how to test it for electrical trouble, how to disassemble it, clean it, check armature and field coils, put in new parts, assemble it and test.

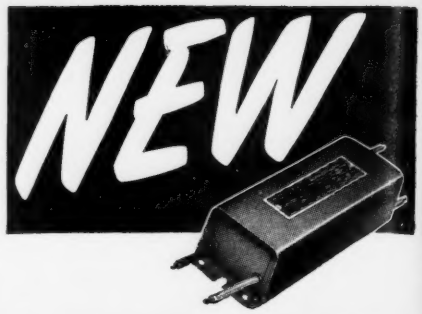
After about 60 days at this general repair desk they move on and are taught how to strip armatures and wind and insulate field coils. Next they are taught how to lay armature leads in the proper commutator slots and finally go on to the armature winding machine. About four girls are trained specifically for armature winding since this is an important adjunct to the spare

***FINAL TEST** is given serviced drills at this test panel which checks running condition, polarity and ground connection. Operator then color codes end bell, automatically setting time of next general servicing.*

parts department. With a girl able to wind from 80 to 100 armatures per day, an absence would put a pretty big crimp in the spare stock.

What is the net result of this carefully planned and executed electric drill maintenance program? It means that the cost of repairs averages less than $1.50 per drill (including everything from a smashed cord plug to a completely rewound drill). This figure includes *only the cost of labor, material and departmental supervision.* It does not include overhead (plant space, paper work, etc.), investment.

On the surface, electric drill repairs may seem to be a superficial item. However, in a plant of this type it is an exceedingly important function from the standpoint of both production efficiency and cost.



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IN THIS ISSUE... Hi-voltage for light distribution . . . What's ahead in the '45 Code ...How to organize for small motor repair . . . . Contractors are good pay . . . What to do about electrical apparatus fires . . . How the adequate wiring campaign is doing... More about selecting controls for squirrel-cage motors... How to shoot trouble on electronic apparatus . . . And a host of practical ideas for the shop and the job.